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FINAL REMEDIAL INVESTIGATION REPORT

**Havertown PCP Site
Haverford Township
Delaware County, Pennsylvania**

Volume 1, Chapters 1 - 4

**DER Agreement Number ME - 86110
REWAI Project Number 86021**

By

**R. E. WRIGHT ASSOCIATES, INC.
3240 Schoolhouse Road
Middletown, PA 17057**

September 1988

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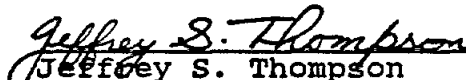
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REWAI Project Number 86021

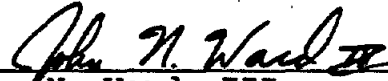
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September 1988

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Abbreviations

AT	- Apparent Thickness
ATH	- Ambient Temperature Headspace
b	- Saturated Thickness
BDL	- Below Detection Limit
BNA	- Base Neutral/Acid Extractable (Chemicals)
°C	- Degrees Celcius
CAL	- California Analytical Laboratory
CCA	- Chromated Copper Arsenate
CERCLA	- Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)
CLP	- Contract Laboratory Program
CMP	- Corregated Metal Pipe
CompuChem	- CompuChem Laboratories
CW	- Cluster Well
CZC	- Chromated Zinc Chloride
DER	- Pennsylvania Department of Environmental Resources
D.O.	- Dissolved Oxygen
E & E	- Ecology and Environment, Inc.
EPA	- U. S. Environmental Protection Agency
Empire	- Empire Soils Investigations, Inc.
°F	- Degrees Fahrenheit
FCAP	- Fluro Chrome Arsenate Phenol
FID	- Flame Ionization Detector
FS	- Feasibility Study
ft	- Feet
ft/day	- Feet Per Day
gpd/ft ²	- Gallons Per Day Per Foot Squared
GPG	- Greeley-Polhemus Group, Inc.
h	- Change in Hydraulic Head
HNO ₃	- Nitric Acid
h.p.	- Horsepower
HSL	- Hazardous Substance List
H ₂ SO ₄	- Sulfuric Acid
I	- Hydraulic Gradient
ID	- Inside Diameter
K	- Hydraulic Conductivity
l	- Liter
L	- Distance
mg/kg	- Milligrams Per Kilogram
mg/l	- Milligrams Per Liter
ml	- Milliliters
MSL	- Mean Sea Level
n	- Porosity
NaOH	- Sodium Hydroxide
NCP	- National Contingency Plan
NWP	- National Wood Preservers, Inc.
O & G	- Oil and Grease

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Abbreviations (Cont'd)

OVA	- Organic Vapor Analyzer
PAGS	- Pennsylvania Geologic Survey
PAH	- Polynuclear Aromatic Hydrocarbons
PCB	- Polychlorinated Biphenols
PCG	- Philadelphia Chewing Gum Company
PCP	- Pentachlorophenol
PCRR	- Pennsylvania Central Railroad
PDH	- Pennsylvania Department of Health
pH	- Potential Hydrogen
PID	- Photoionization Detector
ppb	- Parts Per Billion
ppm	- Parts Per Million
ppt	- Parts Per Trillion
psi	- Pounds Per Square Inch
PVC	- Polyvinyl Chloride
QA/QC	- Quality Assurance/Quality Control
OSC	- On-site Coordinator (EPA)
RA	- Risk Assessment
REWAI	- R. E. Wright Associates, Inc.
RFP	- Request for Proposals
RI	- Remedial Investigation
RQD	- Rock Quality Designator
SAS	- Special Analytical Services (Regional CLP Request)
Sch.	- Schedule
SCT	- Salinity, Conductivity, Temperature (Meter)
SID	- Shallow, Intermediate, Deep
SOP	- Site Operations Plan
Superfund	- Hazardous Substance Response Trust Fund
SWL	- Static Water Level
TBTO	- Tributyl Tin Oxide
TEF	- Toxicity Equivalent Factor
TWT	- Thickness of Oil Below the Water Table
ug	- Microgram
USCS	- Unified Soil Classification System
USDA	- United States Department of Agriculture
USTC	- United States Testing Corporation, Inc.
V	- Average Groundwater Velocity
VOA	- Volatile Organic Aromatic
WLSI	- Wright Lab Services, Inc.
Xw	- Wissahickon Formation
X,Y,Z	- Coordinate Axes
YSI	- Yellow Springs Instruments

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ACKNOWLEDGMENTS

The remedial investigation fieldwork was performed by Mr. Jeff Thompson, Mr. John Ward, Mr. Eric Roof, Mr. Steve Rowley, and Mr. Jim Davis, under the supervision of REWAI's project director, Mr. Eric Slavin, P.G., and the executive vice president, Mr. Ned Wehler. The report was coauthored by Mr. Jeff Thompson and Mr. John Ward, with input from Mr. Steve Rowley in chemical data reduction sections. Report illustrations were produced by Ms. Christine Slates, Mr. Richard Saladin, Mr. Alex Mackey, and Mr. Savannarith Som. Chemical spreadsheets were tabulated by Mr. Matt Myers and Mr. Eric Roof. Word processing and report compilation were diligently completed by Ms. Pamela Ratliff, Ms. Darlene Politz, Ms. Janelle Lauzon, Ms. Melissa Smith, Ms. Barbara Neidigh, and Ms. Angelique Trombino. Reproductions of the report were run by Mr. John Oram and Ms. Brenda Rodriguez.

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The assistance and cooperation of Mr. Gary Moulder (DER) throughout this investigation are greatly appreciated by REWAI and the staff of this project.

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EXECUTIVE SUMMARY

An agreement between the Pennsylvania Department of Environmental Resources (DER) and R. E. Wright Associates, Inc. (REWAI) of Middletown, Pennsylvania, was formalized on September 16, 1986, to conduct a Remedial Investigation and Feasibility Study (RI/FS) at a site known as the Havertown PCP site in Haverford Township, Delaware County. The RI/FS was needed to investigate and define the hydrogeologic characteristics and extent of contamination at the site so that a remedial design could be produced to mitigate and remove the subsurface pentachlorophenol (PCP) contaminated fuel oil plume which resulted from improper disposal practices at a wood-treatment plant known as National Wood Preservers, Inc. (NWP). Between 1947 and 1963, spent or waste preservatives were dumped into an abandoned well, approximately 25 to 35 feet deep, located on the property. The ensuing subsurface oil plume and subsequent groundwater contamination which resulted from this action were brought to the attention of DER in 1972, when area residents complained of pollution problems (oil) in a nearby stream known as Naylor's Run. A series of court trials, appeals, investigations, and recovery activities followed. The site was eventually placed at 399 on the National Priority List of Superfund sites by the United States Environmental Protection Agency (EPA).

On June 1, 1987, DER provided REWAI with written notice to proceed on the project. The objective of the Havertown PCP site RI/FS was to identify, characterize, and analyze the contamination both on- and off-site; to determine the extent to which it poses a danger to public health, welfare, or the environment; and to obtain the necessary data for the development and evaluation of remedial action alternatives and risk assessment.

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In summary, the remedial investigation (RI) phase of the project was composed of an initial site reconnaissance and background air quality sampling. The information obtained was used to plan the mobilization of site trailers, utilities, and decontamination requirements prior to initiation of field operations. To further define site characteristics and to evaluate health and safety concerns, a preliminary sampling round was conducted in which 10 existing monitoring wells, 16 soil samples from NWP, and 10 surface water and 10 sediment samples from Naylor's Run were collected and analyzed for the Hazardous Substance List (HSL) and isomers of dioxin and dibenzofuran.

Following a review of the results obtained from the preliminary sampling round, DER-approved modifications were made to the hydrogeologic investigation. The modifications consisted of increasing the level of worker protection and decontamination in response to the presence of dioxin at the site, and the relocation of the six cluster well locations to their present positions: two on NWP-leased property and four on Philadelphia Chewing Gum Company (PCG) property. Following installation of 18 new monitoring wells at the 6 locations mentioned previously, hydrogeologic testing was conducted on both the consolidated and unconsolidated aquifers. A second round of groundwater sampling was then initiated which included sampling the 10 existing monitoring wells and the 18 new monitoring wells.

The results of all data collected have been analyzed and are presented here in this final RI report. With DER's approval, the risk assessment has been moved into the feasibility study program for contractual simplification.

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1.0 INTRODUCTION

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1.0 INTRODUCTION

In compliance with the Contract Agreement dated September 16, 1986, between the Commonwealth of Pennsylvania, Department of Environmental Resources (DER), and R. E. Wright Associates, Inc. (REWAI), a Remedial Investigation/Feasibility Study (RI/FS) was conducted at a location known as the Havertown PCP site, located in Havertown, Haverford Township, Delaware County, Pennsylvania. To complete the RI/FS, REWAI, as prime contractor, engaged the services of specialty subcontractors. The Greeley-Polhemus Group, Inc. (GPG), under subcontract to REWAI, will conduct the Risk Assessment (RA) portion of the RI/FS in conjunction with the Feasibility Study (FS). Additional subcontractors to REWAI include U. S. Testing Corporation, Inc. (USTC), who conducted three rounds of air quality sampling and analysis as part of the RI; Empire Soils Investigations, Inc. (Empire), who served as the drilling subcontractor; and CompuChem Laboratories (CompuChem), who served as the analytical laboratory for the RI.

The primary objectives of the Havertown PCP site RI/FS were:

- o To determine the nature and extent of contamination which was or is being released or discharged from the Havertown PCP site to surrounding areas.
- o To determine the current and potential future impacts this contamination is or may be posing to the environment and public health in the site vicinity.
- o To identify technologies and evaluate their appropriateness/applicability for remediating on-site and off-site

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contamination and for compliance with federal, state, and local laws and regulations.

Field investigations were conducted by REWAI at the Havertown PCP site to determine the nature and extent of contamination and included:

- o Sediment sampling in and along Naylor's Run.
- o Surface water sampling in Naylor's Run.
- o Soil sampling on National Wood Preserver (NWP) operated property.
- o Monitoring well drilling, development, hydrogeologic testing, and groundwater sampling.
- o Air monitoring of the NWP plant site to ascertain air quality before, during, and after the investigation.
- o A general site reconnaissance to attain information necessary for aiding in the interpretation of the contamination problem at the Havertown PCP site.
- o Site survey and mapping conducted to provide a base map for coordination of the investigation and a base from which to analyze data.

In addition to the above RI field investigations, a risk assessment (RA) will be conducted to determine the current and potential future impacts that this contamination is or may be posing to the environment and public health in the site vicinity.

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With the concurrence of DER, the RA will be completed during the FS.

Upon completion of the Havertown PCP site RI, an FS will be conducted to identify technologies and evaluate their appropriateness and applicability for remediating on- and off-site contamination.

1.1 Site Background Information

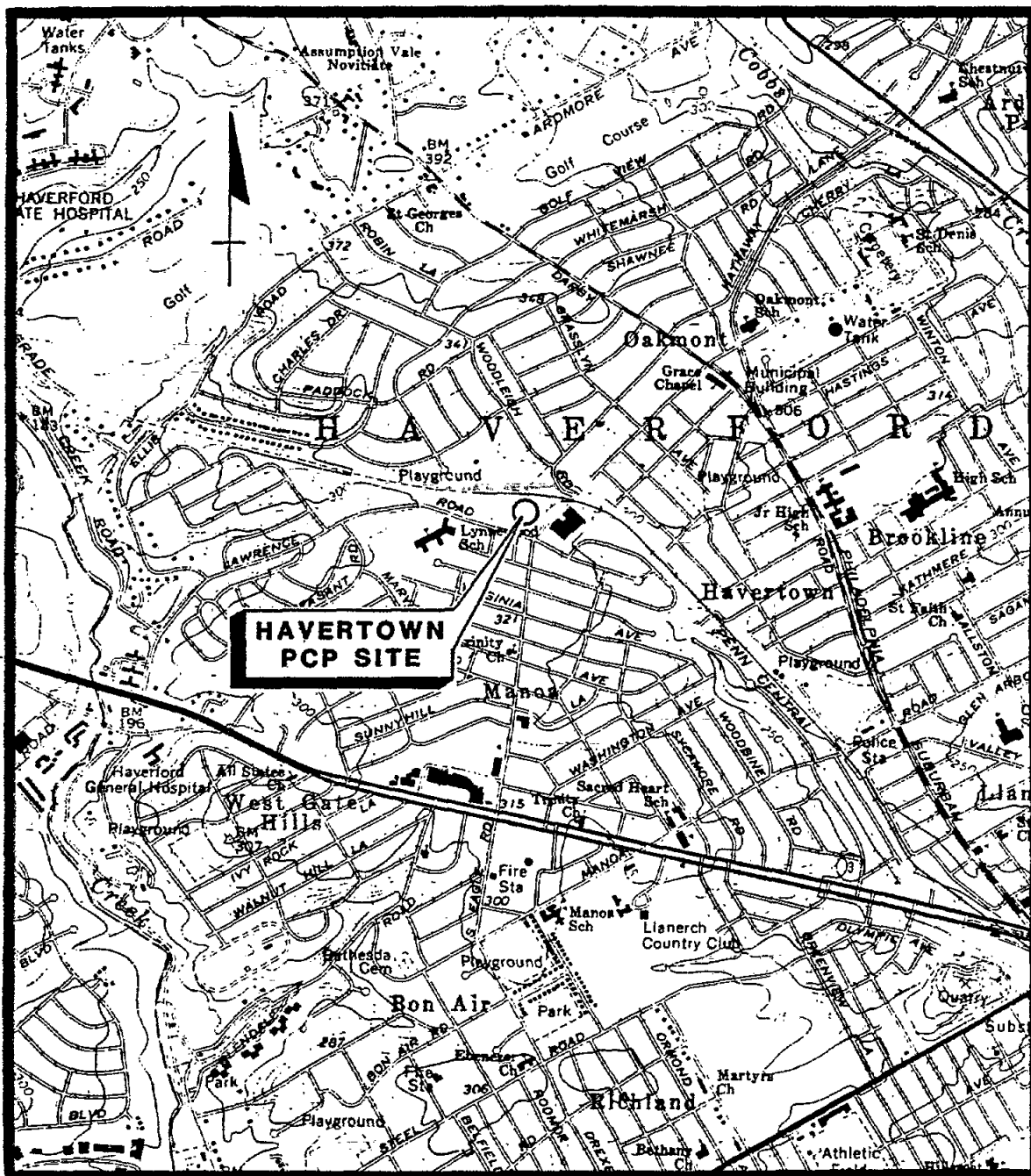
1.1.1 Site Location

The Havertown PCP site is located in Havertown, Haverford Township, Delaware County, in the southeastern portion of Pennsylvania. The site, as shown on Figure 1-1, is located approximately 10 miles west of Philadelphia and is surrounded by a mixture of commercial establishments, industries, parks, schools, and residential homes.

The investigated area essentially consists of a wood-treatment facility operated by NWP, a bubble gum manufacturing plant owned by the Philadelphia Chewing Gum Company (PCG), and neighboring residential and commercial areas.

NWP is the center of the investigative activity. Structures on the property consist of a single sheet metal building with multiple aboveground chemical storage tanks situated on a two-acre property just north of the intersection of Eagle Road and Lawrence Road.

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BASE MAP: FROM LANSDOWNE, PA, 7 1/2 MINUTE USGS TOPOGRAPHIC QUADRANGLE

2000' 0 2000'
SCALE IN FEET

FIGURE 1-1

HAVERTOWN PCP SITE		
HAVERTOWN, PA		
LOCATION MAP		
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checked <i>JST</i>	date 4-22-88	86021-014-AA
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The PCG facility consists of a single large bubble gum production building located due east of NWP (northeast of the intersection of Eagle Road and Lawrence Road). The residential areas bordering Rittenhouse Circle and Naylor's Run comprise the remainder of the study area. The entire Havertown PCP site consists of approximately 12 to 15 acres and is roughly delineated by Lawrence Road and Rittenhouse Circle to the south, the former Penn Central Railroad (PCRR) tracks to the north, and the fence between NWP and Continental Motors to the west. There is no distinctive boundary to the east. Figure 1-2 shows a general map view of the site.

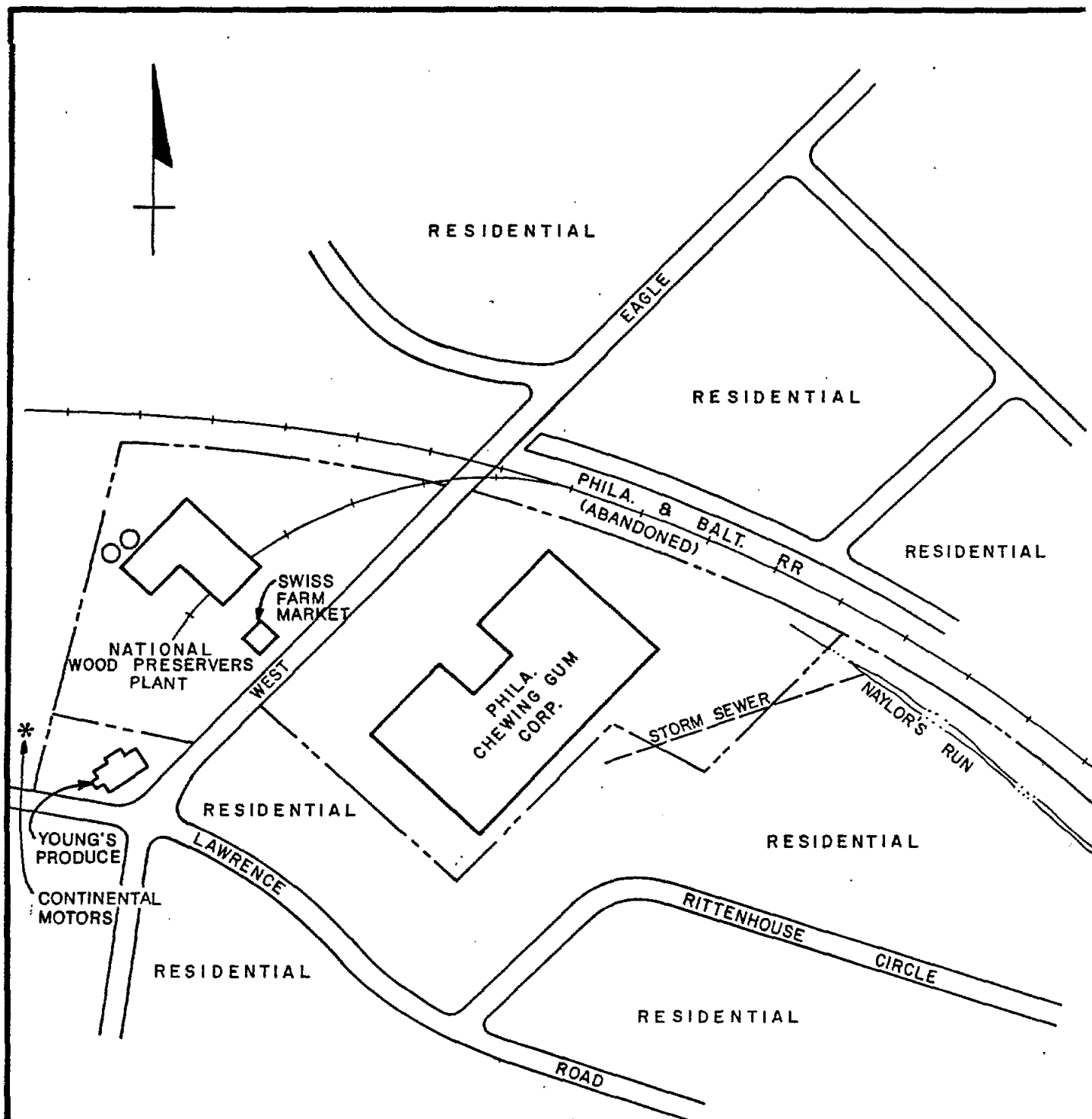
1.1.2 Physiography

1.1.2.1 Topographic Setting - The Havertown PCP site is located in the Piedmont Uplands section of the Piedmont Physiographic Province, and is characterized by maturely dissected hills sloping gently to the southeast underlain by crystalline igneous and metamorphic rocks and metamorphosed sedimentary rocks. The Piedmont Uplands section is the most southerly section of the Piedmont Province in Pennsylvania.

The site itself is situated in an area that is relatively flat when compared to the surrounding countryside. Elevations range from approximately 320 feet above mean sea level (msl) in the vicinity of Continental Motors and decrease in an east-southeast direction to approximately 280 feet above msl in the residential areas along Rittenhouse Circle.

Much of the site's original topography has been altered by cut and fill activities which have occurred on both the NWP plant site and PCG property. NWP property is currently very flat.

APR 30 1980 17



200' 0 200'
SCALE IN FEET

FIGURE 1-2

HAVERTOWN PCP SITE
HAVERTOWN, PA
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STUDY AREA MAP

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checked JST	date 4-22-88	86021-013-AA
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barely one foot of relief occurring. PCG property is also quite flat, with the exception of a 12- to 15-foot embankment which is located at the back of their property. The embankment was caused by the large quantity of fill used at this location during the course of the expansion of their building.

1.1.2.2 Surface Waters - The Havertown PCP site is drained entirely by Naylor's Run, which flows in a southeasterly direction from the site through natural channels, concrete-lined man-made channels, and a variety of pipes before entering Cobbs Creek near East Lansdowne, approximately four miles southeast of the site. Not far below this confluence, Cobbs Creek enters Darby Creek, and eventually flows through the Tinicum Wildlife Preserve before emptying into the Delaware River just east of Chester, Pennsylvania.

For the most part, surface runoff across the site enters artificial drainage channels, such as storm sewers, before discharging into Naylor's Run. On NWP-operated property, a significant amount of water ponds in the area of the pedestrian gate in the vicinity of Continental Motors, along NWP's side exit, and in the vicinity of NWP's main exit gate near Eagle Road. Subsequently, this water either evaporates or percolates into the ground. When precipitation is significant, a large amount of sheet flow occurs on NWP-operated property and exits through the main gate near Eagle Road before emptying into a drainage ditch which borders the abandoned PCRR railroad bed north of the property. The eventual fate of this runoff is Naylor's Run. Smaller amounts of sheet flow also occur across other portions of NWP.

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Surface water runoff on PCG property occurs almost exclusively as sheet flow across the parking areas with eventual discharge to storm sewers and Naylor's Run. Some ponding of water does occur in parking lot depressions, and a small amount of water also percolates into the ground in grassy and un-macadamed areas.

1.1.2.3 Groundwater - Groundwater in the vicinity of the Havertown PCP site occurs in the surface soils; the weathered schist saprolite zone, which results from the chemical weathering of metamorphic schist rocks; and the unweathered biotite gneiss bedrock. The two most significant zones for groundwater flow at the Havertown PCP site are the weathered saprolite zone and bedrock.

Groundwater movement in the weathered saprolite zone is predominantly intergranular, with the degree of weathering, the nature of the weathered material, and remnant bedrock structures all affecting flow to varying degrees. In addition, the thickness of this weathered saprolite zone is important for storage of water which recharges the underlying fractured bedrock.

Bedrock in the area also contains substantial quantities of groundwater. The bedrock is highly fractured and jointed due to intense deformation, and most of the groundwater flow occurs through interconnected fractures and joints. In unweathered bedrock, the joint planes and fractures may decrease in number and in the size of the opening with increasing depth. Therefore, weathering of the bedrock, which would increase its permeability, would appear to decrease with depth and subsequently the permeability would likely decrease with depth.

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There are no known production wells in the vicinity of the Havertown PCP site, and a public water supply distribution system, operated by Philadelphia Suburban Water Company, is present. However, several groundwater monitoring wells are present to define conditions beneath the site. The depth to groundwater ranges from approximately 23 feet below ground surface in the vicinity of Young's Produce Store, to approximately 0.5 feet below ground surface in the Rittenhouse Circle area. The elevation of groundwater and its flow direction are expected to be controlled by topography, Naylor's Run, geologic structure, and artificial drainage structures. Groundwater in the vicinity of the site flows in an easterly direction, with some unknown portion of the flow discharging to Naylor's Run.

1.1.2.4 Generalized Soil Types - The Havertown PCP site is located entirely within Delaware County. Soil types mapped by the United States Department of Agriculture (USDA) in the study area are discussed herein.

Only one natural soil type, the Glenville silt loam, was mapped by the USDA in the study area (USDA, 1963). The Glenville silt loam is a deep, moderately well-drained soil which developed in material weathered mainly from granite, schist, and gneiss. The dominant parent material for this soil type is mica schist and gneiss. The surface layer is normally very dark brown or dark grayish-brown silt loam, while the subsoil is yellowish-brown or strong-brown, mottled silty clay loam or heavy silty loam. Mottling in this soil usually occurs at a depth ranging from 15 to 30 inches, permeability is moderately low, and the available moisture capacity moderately high. The Glenville silt loam soil is generally found on low-lying areas in uplands and floodplains.

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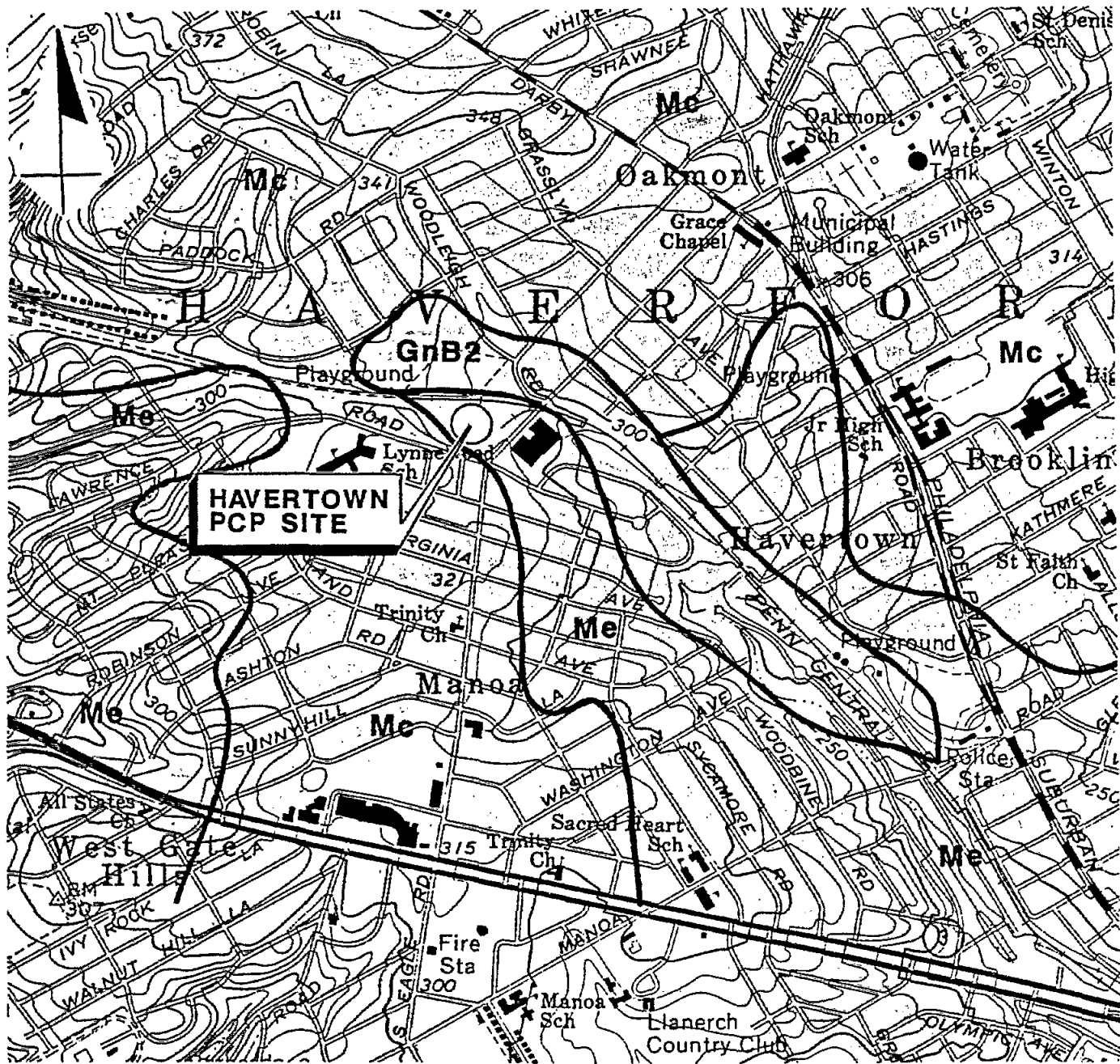
the heads of streams where the water table is high in the subsoil for long periods (USDA, 1963).

The USDA classifies soils which have been altered to some degree by man as made land. Made land typically includes areas of severely eroded land, urban areas, filled areas, railroad rights-of-way, and artificially made land. These areas are often stony, steep, or unproductive and have no continuous mantle of soil. The majority of the soils at the Havertown PCP site are classified as one of the made land types. The first made land type consists of areas in which earth-moving equipment has destroyed or covered the profile of the normal soil. In most places, the exposed materials consist of silt and clay, but small areas of sandy and gravelly materials are intermingled with the silt and clay. The second made land type found in the study area also consists of areas in which earth-moving equipment has destroyed or covered land for urban or industrial development. However, soil material in this type of made land consists of a mixture of grayish-brown material from the surface layer, silt loam from the subsoil, and partially weathered micaceous schist and gneiss rocks. Figure 1-3 shows a map of soils in the study area based on 1963 USDA mapping.

1.1.2.5 Geologic Setting

1.1.2.5.1 Unconsolidated Deposits - The most common unconsolidated lithologies present at the Havertown PCP site study area are saprolite, sand and gravel terrace deposits, and artificial fill.

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BASE MAP: FROM LANSDOWNE, PA 7.5 MINUTE USGS TOPOGRAPHIC QUADRANGLE

LEGEND

Mc	MADE LAND (SILT/CLAY)
Me	MADE LAND (SCHIST/GNEISS)
GnB2	GLENVILLE SILT LOAM



FIGURE 1-3

HAVERTOWN PCP SITE

HAVERTOWN PA 080023

SOIL MAP

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checked <i>JST</i>	date <i>4-25-88</i>	

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earth resources consultants
middletown, pa. westminster, md

(BASED ON USDA, 1963 SOIL SURVEY OF CHESTER AND DELAWARE COUNTIES)

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Saprolite is a soft, earthy, clay-rich soil, consisting of thoroughly decomposed rock. It was formed in place by the chemical weathering of igneous, metamorphic, or sedimentary rocks. Saprolite typically forms in humid, tropical, or subtropical climates. Saprolite is widespread at the site, normally underlying the fill and overlying the gneiss or schist bedrock and ranges from 10 to 30 feet thick. No surface outcrops of saprolite were noted at the site.

Two distinct saprolite units were present underlying the Havertown PCP site. The uppermost unit was a medium brown, highly micaceous saprolite which was highly weathered and exhibited only faint remnant structures. The second saprolite was a dark brown to gray, biotite schist saprolite, which occurred directly overlying bedrock, and was not as weathered as the upper saprolite unit. This unit also exhibited prominent remnant structures such as foliation planes. Texturally, both saprolite units are sandy in nature with varying amounts of clay, silt, and gravel also present. The parent material for the saprolites found at the Havertown PCP site are biotite schist and biotite-quartz-feldspar gneiss.

Also present in the site vicinity, although not definitely encountered during this investigation, are surficial sand and gravel terrace deposits that are Pleistocene in age. These deposits are usually less than 20 feet thick. Two known terrace deposits exist near the towns of Bryn Mawr and Grassland, and are known respectively as the Bryn Mawr and Brandywine Terraces (Hall, 1967). Typically, the Bryn Mawr gravel is composed of highly decomposed ferruginous conglomerate which may be found as fragments and rounded milky quartz pebbles in the soil. Boundaries of this unit are usually marked by indistinct terraces.

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and escarpments. The gneiss bedrock underlying these sand and gravel deposits is always heavily decomposed (Hall, 1985).

The final unconsolidated material present at the Havertown PCP site is artificial fill, which consists of both reworked natural materials that were indigenous to the site, and materials such as cinders, sand and gravel, and silt and clay that were brought into the area for construction purposes. The fill material generally exhibits no structure and is poorly sorted. Thickness of the fill unit across the site varies from 0 feet to approximately 16 feet.

1.1.2.5.2 Bedrock Geology - Bedrock in the site vicinity consists of metamorphic rocks of the Wissahickon Formation. The Wissahickon Formation is the prominent hard rock formation in the area and exhibits a wide range of metamorphism, ranging from phyllite through schist, to gneiss. As far as regional mapping, the Wissahickon Formation has been divided into two facies by Bascom and Stose (1932). The northern facies is typically a phyllite and is composed chiefly of quartz, feldspar, muscovite, and chlorite. Bedding in this facies is rarely visible, but where seen, it is nearly parallel to the cleavage (Poth, 1973).

The southern facies is more coarsely crystalline than the northern facies and is commonly called an oligoclase-mica schist. According to Bascom and Stose, the southern facies is separable into two "gneissic" members. The upper member is a muscovite gneiss that is highly micaceous and actually more schistose than gneissic. This member is composed predominantly of quartz, feldspar, and muscovite. The lower member, which is thought to be present in the Havertown area, is predominantly a biotite gneiss, with abundant injections of granitic and gabbroic

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pegmatites. The biotite gneiss also appears schistose in some areas, with feldspars quite abundant in this member. Because of intense folding and the lack of recognizable recurrent beds, the thickness of the Wissahickon is not known. In addition, the precise geologic age of the Wissahickon Formation has been debated and is usually listed from Precambrian to Ordovician.

More site-specific, the Wissahickon Formation is comprised of varying grades of metamorphosed rock which underlie a large portion of Haverford Township, Delaware County (Hall, 1967). Throughout the township, the Wissahickon Formation varies considerably in lithology, ranging from a gneiss to a schist.

Within the site vicinity, rocks from this unit generally consist of a finely plicated, medium-grained matrix of biotite, muscovite, and quartz, with varying amounts of feldspar, chlorite, and garnet. This rock is commonly called an oligoclase-mica schist, and unweathered rocks from this unit are dense and have a low primary porosity. However, extensive jointing that occurs in this formation provides numerous openings for the storage and transportation of groundwater. Details concerning the precise lithology of the Wissahickon Formation underlying both NWP and PCG, as determined from the installation of new monitoring wells, are presented in Section 5.1.

Another rock type that is commonly found in the study area is pegmatite. Pegmatite is abundant in the area as sill-like bodies which generally have a strike similar to that of the enclosing formation and a dip which approximates the schistosity of the formation. In many places, it is present as a series of lenses rather than a continuous body. Bascom and Stose (1932) note that

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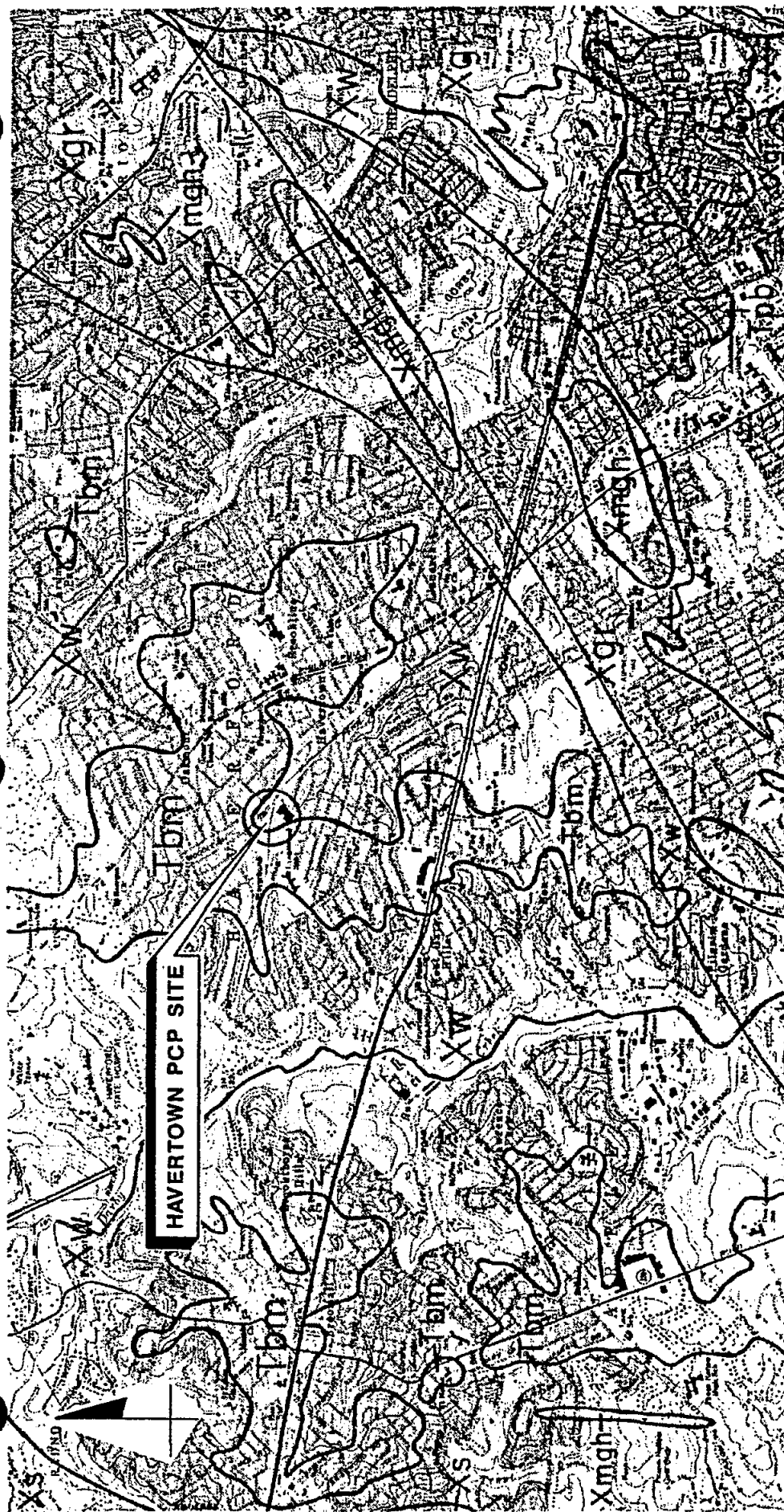
there are innumerable paper-thin injections of pegmatite in the gneiss which completely alter the character of the invaded rock.

In the Wissahickon Formation, the pegmatite occurs in the middle and high grade zones of metamorphism and is reportedly of local derivation, as the lenses have the same composition as the surrounding rock (predominantly quartz, feldspar, biotite, and muscovite). Pegmatite seems to be absent from the zone of low grade metamorphism, but lenses similar in shape to pegmatite lenses of the higher grade metamorphosed zones are present and consist of quartz, calcite, and albite (McKinstry, 1961).

Additional rock types mapped by the Pennsylvania Geological Survey (PAGS) in the area, although not known to occur specifically beneath the site, include a granitic gneiss and granite, which may be granitized Wissahickon, and a mafic gneiss that is hornblende-bearing and is probably of sedimentary origin. Figure 1-4 shows a geologic map for the regional area surrounding the site. The Bryn Mawr Formation, which occurs in the vicinity of the Havertown PCP site, was discussed in Section 1.1.2.5.1.

1.1.2.5.3 Bedrock Structure - The complexity of the geology and a general lack of good exposures of rock have made interpreting the geology of Delaware County somewhat difficult. Previous geologic investigations have shown that there are apparently no faults of any consequence within Delaware County which would affect the relationship of the metamorphic rocks. In addition, it was determined that the usual orientation of cleavage throughout the major portion of the metamorphic belt in Delaware County has a strike of N10°E and a dip ranging between 75° and 90° (Hall, 1885).

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BASE MAP: FROM USGS LANSOWNE PA, 7.5 MINUTE TOPOGRAPHIC QUADRANGLE

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LEGEND

Qt	TRIANTON GRAVEL	Xmg	MAFIC GNEISS, HORNBLende-BEARING
Tpb	PENSAUKEN AND BRIDGETON FMS., UNDEF.	Xs	SERPENTINITE
Tbm	BRA MAWR FM.	Xw	WISSAHICKON FM, OLIGOCLEASE-MICA SCHIST
Xgr	GRANITIC GNEISS AND GRANITE		

3520' 0 3520'
SCALE IN FEET

FIGURE 1-4

HAVERTOWN PCP SITE
HAVERTOWN, PA

GEOLOGIC MAP

Drawn C.C.S.	REGISTERED	drawing no.
Checked JST	Geologist	86021-016-AA
	Date 7-26-88	

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earth resources consultants
Havertown, Pennsylvania

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Joint surfaces, cleavage, and bedding planes are all types of fractures that occur in the metamorphosed rocks of the Wissahickon Formation. Fractures such as these aid in the storage and transport of groundwater in the unweathered rock. Consequently, the orientation of these fractures or their expression on the ground surface (fracture traces) is important in accessing the flow of water through the bedrock. Figure 1-5 shows a generalized cross-section of geologic conditions in the site vicinity.

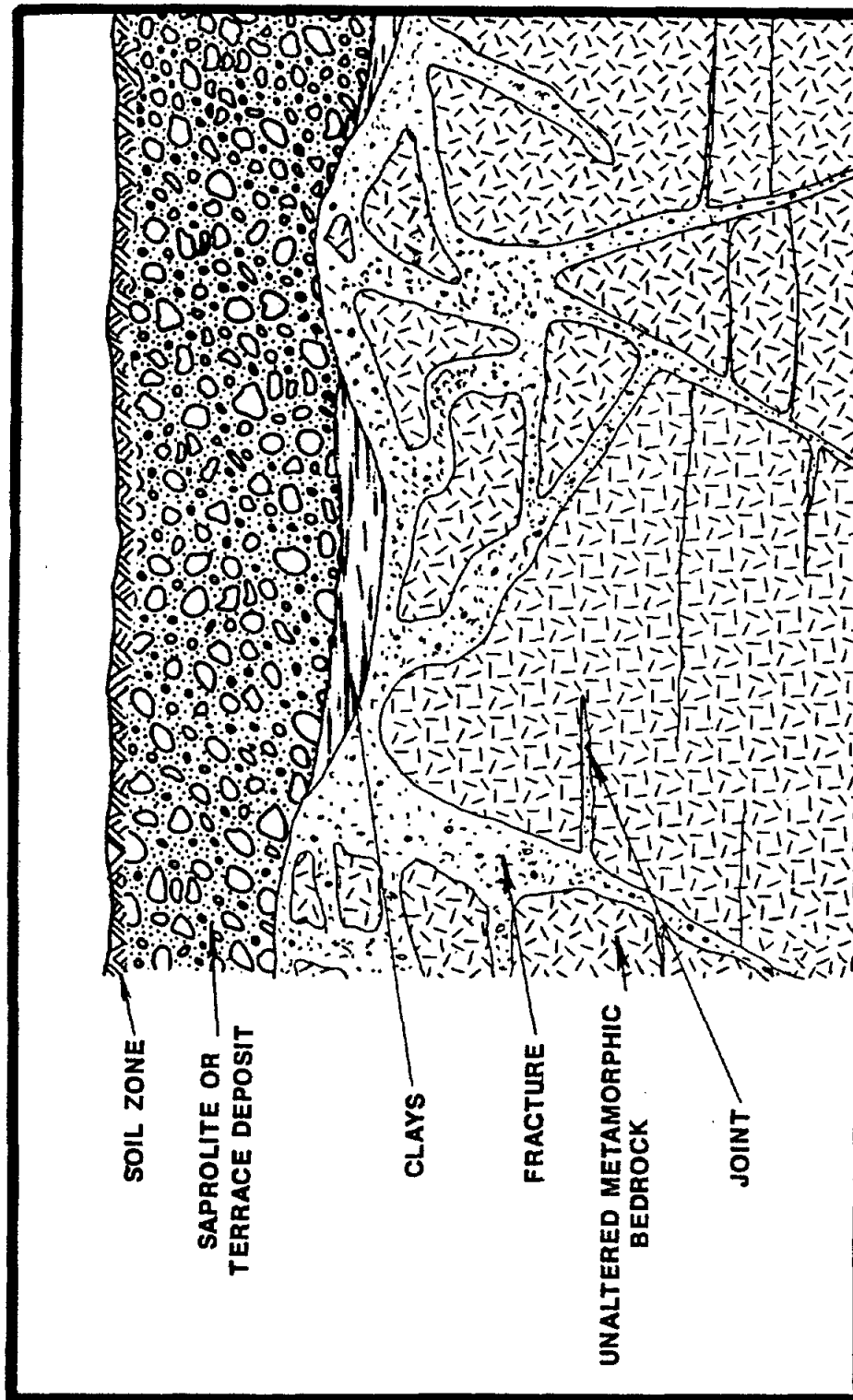
1.1.3 Description of NWP Facilities

1.1.3.1 Facility Type and Historical Operations - The NWP facility was originally constructed by Mr. Samuel T. Jacoby in 1947 on property leased from the Mr. Clifford Rogers estate. Conversations with local citizenry indicate that prior to the construction of the NWP facility at this location, the site first served as a railroad storage yard, followed by a lumberyard, and the Jacoby wood-preserving plant. In 1963, the existing wood-treatment facility was purchased by the Goldsteins.

The facility has not changed significantly since its construction in 1947 and today consists of a single metal-sheeted building, which contains the wood-treatment equipment, and several chemical storage tanks, located immediately northwest of the building. The production facility is surrounded by a dirt-covered storage yard, in which both untreated and treated wood are stored. The entire NWP facility is enclosed by a chain-link fence. During the period of 1963 to 1964, some basic chemical containment and chemical recycling modifications were

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(Source - After Driscoll, F.G. Groundwater and Wells, Johnson Division, 1986 p.44.)

NO SCALE

FIGURE 1-5

HAVERTOWN PCP SITE HAVERTOWN, PA			
GENERALIZED CROSS-SECTION OF HYDROGEOLOGIC CONDITIONS			
drawn CJS	checked JST	drawing no.	86021-015-AA
 R. O. Wright Associates, Inc. earth resources consultants			

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made to the facility by the Goldsteins, as requested by DER (Todd, 1984).

NWP custom-treats wood as requested by clients, who supply the materials to be treated. Wood preservation is carried out to prevent decay or insect infestation of woods used for construction purposes where the wood will be constantly exposed to the environment. The type of wood treated at this facility is determined by the client, who supplies the material precut and dried, so that other than loading, treating, unloading, and storing wood, essentially no other tasks are performed at this facility. The entire operation at this facility is presently manned by two employees.

Historically, two wood-treating processes have been used at this facility. The first is commonly referred to as the Empty Cell Pressure Treatment Process, and this facility has three pressure treatment cylinders for conducting this process. The two pressure treatment cylinders inside the main plant building are 6 feet in diameter and 50 feet in length. These are designed so that wood is brought into the chamber from the east end on tram cars, after which doors at both ends of the chamber are bolted and sealed and the wood is treated. The treatment solutions remaining in the pressure treatment cylinder after completion of wood treatment are pumped to outside chemical storage tanks and the treated wood is removed from the west end of the chamber using a winch. The treated wood is then air dried on drip tracks and stored on-site until being returned to the customer. The cylinder doors are the older manually operated type rather than the modern hydraulic units currently available (Todd, 1984).

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The outside pressure cylinder opens manually only at one end and is 5 feet in diameter and 40 feet long. Untreated wood is placed on skids and moved into the treatment chamber using a forklift. As with the other two units, the solutions remaining after treatment are pumped to the outside chemical storage tanks. Any of the three pressure treatment cylinders could utilize the various wood-treatment chemicals that have been used at the site over the years of the facility's existence (Todd, 1984).

The second wood-treatment process used at this plant is a Non-Pressure Dip Treatment which consists of a chemical application to the wood's surface primarily for control of fungus or insects where no direct soil contact is expected. This method has also been used for fire-retardant treatment of wood. The dip tank used in this process is built to be above ground level, has simple non-hinged metal covers, and has dimensions that are 6 feet by 6 feet by 62 feet (Todd, 1984).

1.1.3.2 Wood-Treatment Chemicals Used at NWP (1947 to Present)

- The wood-treatment solution most commonly used at the NWP facility from 1947 to 1978 was five percent pentachlorophenol (PCP) mixed in a petroleum solvent similar to diesel fuel. The diesel fuel oil is sometimes referred to as P-9 Type A oil and has a characteristic fuel oil refinery odor that is detectable at less than one part per million (ppm) in air. It is likely that during the plant's early years, PCP was purchased in block or flake form and mixed with the oil solution by heating in one of the cylinders on-site. More recently, this PCP/oil solution became available from suppliers as premixed, 5 or 10 percent solution which was purchased in tank-truck quantities (Todd, 1984).

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The second wood-treatment chemical commonly used during the early years of wood treatment at the NWP plant was Tantalithe, which is a trade name for a salt-treating solution chemically known as Fluoro Chrome Arsenate Phenol (FCAP). FCAP is a water-soluble chemical complex used for wood preservation at one percent or less strength, and was made directly on-site by mixing dry components together with water in the site storage tanks. This treatment is no longer in common commercial use in the wood treatment industry, having been replaced by Chromated Copper Arsenate (CCA), which is both less expensive and a more effective preservative (Todd, 1984).

During the plant's early operational period, when Mr. Jacoby was the owner, only PCP oil was used in the non-pressure treatment method (dip treatment), while both PCP oil and Tantalithe were used in the pressure treatment chambers. The type of treatment provided to the wood was, and still is, a function of the customer's request (Todd, 1984).

Prior to 1978, PCP was also mixed with mineral spirits at NWP. However, in 1977 to 1978, the use of the PCP oil mix and the PCP/mineral spirit mix were discontinued and replaced by the newer water-soluble solutions. The mineral spirits were commonly referred to in the trade as P-9 Type-C oil, which is a lighter, more volatile, clear solvent that produces essentially no color change in the treated wood. Even though this mixture is more volatile, the odor is much less noticeable and it was available as a premixed solution in tank-truck quantities. This mixture was used in both the pressure treatment method and the dip treatment method (Todd, 1984).

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In addition to the above-mentioned wood-treatment chemicals, additional treatment chemicals have been used for both wood preservation and fire retardant purposes since the purchase of the plant by the Goldsteins in 1963.

As previously stated, FCAP was replaced by CCA, a waterborne chemical that was first used in the mid-1970's. CCA is applied as a 0.4 percent or 0.6 percent solution in the pressure treatment cells at ambient temperature. The higher percentage solution is used on wood that will be in direct contact with soil, while the lower percentage solution is used on wood that will be used for decking and other similar purposes. Wood that is treated with CCA will have a characteristic light green color. In addition to CCA, a second common commercial material, chromated zinc chloride (CZC), is used for fire-retardant treatment applications. CZC is also applied in the pressure treatment cells at ambient temperatures (Todd, 1984).

Finally, a chemical known as tributyl tin oxide (TBTO), which is dissolved in mineral spirits for treatment purposes, was occasionally used at the NWP plant. TBTO is not commonly used for commercial wood-treatment purposes, but typically is used in shipyard anti-foulant paint formulations for applications to the hulls of large ships. TBTO was only used at the specific request of customers and was applied to the wood in the pressure treatment cells (Todd, 1984).

The release of these chemicals and their by-products to the environment through accidental spillage, tank and line leaks, and on-site disposal is the cause for this RI/FS.

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1.1.3.3 Waste Types Resulting from Wood Treatment Operations - Since 1947, a variety of wood-treatment chemicals have been used at NWP, and in this time, a number of these spent chemical solutions have entered the environment through tank leaks, accidental spillage, and on-site disposal. On-site disposal is not believed to have occurred since the Goldsteins began operating the facility in 1963. Some of these chemicals, chemical solutions, and their by-products are toxic and hazardous, and their discharge to the environment at the Havertown PCP site is the cause for the RI/FS.

Of concern at the Havertown PCP site are any wood-treatment chemicals, chemical solutions, or by-products of these chemicals that occur on the Hazardous Substance List (HSL) as shown in the document entitled "Request for Qualifications And Proposals To Provide Remedial Investigation And Feasibility Study Services At The Havertown PCP Site" issued by DER in August 1985. In addition to chemicals present on the HSL, chlorinated dibenzofurans and dioxin isomers are also contaminants of concern and were added to the analytical list at REWAI's request due to their association with PCP.

The wood-treatment chemicals used at NWP and some of their potential hazards are briefly discussed below. More specific information concerning likely hazardous substances at the Havertown PCP site are included in Chapter 3.0. Chemicals included on the HSL are shown on Tables 1-1, 1-2, 1-3, and 1-4.

1.1.3.3.1 PCP/Oil Mixture - From 1947 to 1978, the primary wood-treatment solution in use at NWP was PCP mixed with a diesel fuel oil. The oil has been identified as an Atlantic-Richfield product called Solvent 57, which is similar to No. 2

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Table 1-1

Hazardous Substance List (HSL) and
Contract Required Detection Limits (CRDL)**

<u>Volatiles</u>	Detection Limits*	
	Low Water ^a (ug/l)	Low Soil/Sediment ^b (ug/kg)
1. Chloromethane	10	10
2. Bromomethane	10	10
3. Vinyl Chloride	10	10
4. Chloroethane	10	10
5. Methylene Chloride	5	5
6. Acetone	10	10
7. Carbon Disulfide	5	5
8. 1,1-Dichloroethene	5	5
9. 1,1-Dichloroethane	5	5
10. trans-1,2-Dichloroethene	5	5
11. Chloroform	5	5
12. 1,2-Dichloroethane	5	5
13. 2-Butanone	10	10
14. 1,1,1-Trichloroethane	5	5
15. Carbon Tetrachloride	5	5
16. Vinyl Acetate	10	10
17. Bromodichloromethane	5	5
18. 1,1,2,2-Tetrachloroethane	5	5
19. 1,2-Dichloropropane	5	5
20. trans-1,3-Dichloropropene	5	5
21. Trichloroethene	5	5
22. Dibromochloromethane	5	5
23. 1,1,2-Trichloroethane	5	5
24. Benzene	5	5
25. cis-1,3-Dichloropropene	5	5
26. 2-Chloroethyl Vinyl Ether	10	10
27. Bromoform	5	5
28. 2-Hexanone	10	10
29. 4-Methyl-2-pentanone	10	10
30. Tetrachloroethene	5	5
31. Toluene	5	5
32. Chlorobenzene	5	5
33. Ethyl Benzene	5	5
34. Styrene	5	5
35. Total Xylenes	5	5

^a Medium Water Contract Required Detection Limits (CRDL) for Volatile HSL Compounds are 100 times the individual Low Water CRDL.

^b Medium Soil/Sediment Contract Required Detection Limits (CRDL) for volatile HSL Compounds are 100 times the individual Low Soil/Sediment CRDL.

* Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the contract, will be higher.

** Specific detection limits are highly matrix dependent. The detection limits listed herein are provide for guidance and may not always be achievable.

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Table 1-2

Hazardous Substance List (HSL) and
Contract Required Detection Limits (CRDL)**

Semi-Volatiles	Detection Limits*	
	Low Water* (ug/l)	Low Soil/Sediment* (ug/kg)
36. N-Nitrosodimethylamine	10	330
37. Phenol	10	330
38. Aniline	10	330
39. bis(2-Chloroethyl) ether	10	330
40. 2-Chlorophenol	10	330
41. 1,3-Dichlorobenzene	10	330
42. 1,4-Dichlorobenzene	10	330
43. Benzyl Alcohol	10	330
44. 1,2-Dichlorobenzene	10	330
45. 2-Methylphenol	10	330
46. bis (2-Chloroisopropyl) ether	10	330
47. 4-Methylphenol	10	330
48. N-Nitroso-Dipropylamine	10	330
49. Hexachloroethane	10	330
50. Nitrobenzene	10	330
51. Isophorone	10	330
52. 2-Nitrophenol	10	330
53. 2,4-Dimethylphenol	10	330
54. Benzoic Acid	50	1600
55. bis (2-Chloroethoxy) methane	10	330
56. 2,4-Dichlorophenol	10	330
57. 1,2,4-Trichlorobenzene	10	330
58. Naphthalene	10	330
59. 4-Chloroaniline	10	330
60. Hexachlorobutadiene	10	330
61. 4-Chloro-3-methylphenol (para-chloro-meta-cresol)	10	330
62. 2-Methylnaphthalene	10	330
63. Hexachlorocyclopentadiene	10	330
64. 2,4,6-Trichlorophenol	10	330
65. 2,4,5-Trichlorophenol	50	1600
66. 2-Chloronaphthalene	10	330
67. 2-Nitroaniline	50	1600
68. Dimethyl Phthalate	10	330
69. Acenaphthylene	10	330
70. 3-Nitroaniline	50	1600
71. Acenaphthene	10	330
72. 2,4-Dinitrophenol	50	1600
73. 4-Nitrophenol	50	1600
74. Dibenzofuran	10	330
75. 2,4-Dinitrotoluene	10	330
76. 2,6-Dinitrotoluene	10	330
77. Diethylphthalate	10	330
78. 4-Chlorophenyl Phenyl Ether	10	330
79. Fluorene	10	330
80. 4-Nitroaniline	50	1600
81. 4,6-Dinitro-2-methylphenol	50	1600
82. N-nitrosodiphenylamine	10	330
83. 4-Bromophenyl Phenyl Ether	10	330
84. Hexachlorobenzene	10	330
85. Pentachlorophenol	50	1600
86. Phenanthrene	10	330
87. Anthracene	10	330
88. Di-n-butylphthalate	10	330
89. Fluoranthene	10	330
90. Benzidine	100	1600
91. Pyrene	10	330
92. Butyl Benzyl Phthalate	10	330
93. 3,3'-Dichlorobenzidine	20	660
94. Benzo(a)anthracene	10	330
95. bis-(2-ethylhexyl)phthalate	10	330
96. Crysenes	10	330
97. Di-n-octyl Phthalate	10	330
98. Benzo(b)fluoranthene	10	330
99. Benzo(k)fluoranthene	10	330
100. Benzo(a)pyrene	10	330
101. Indeno(1,2,3-cd)pyrene	10	330
102. Diben(a,h)anthracene	10	330
103. Benzo(g,h,i)perylene	10	330

* Medium Water Contract Required Detection Limits (CRDL) for Semi-Volatile HSL Compounds are 100 times the individual Low Water CRDL.

* Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Semi-Volatile HSL Compounds are 60 times the individual Low Soil/Sediment CRDL.

* Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the contract, will be higher.

** Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

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Table 1-3

Hazardous Substance List (HSL) and
Contract Required Detection Limits (CRDL)**

<u>Pesticides</u>	<u>Detection Limits*</u>	
	<u>Low Water^e</u> (ug/l)	<u>Low Soil/Sediment^f</u> (ug/kg)
104. alpha-BHC	0.05	2.0
105. beta-BHC	0.05	2.0
106. delta-BHC	0.05	2.0
107. gamma-BHC (Lindane)	0.05	2.0
108. Heptachlor	0.05	2.0
109. Aldrin	0.05	2.0
110. Heptachlor Expoxide	0.05	2.0
111. Endosulfan I	0.05	2.0
112. Dieldrin	0.10	4.0
113. 4,4'-DDE	0.10	4.0
114. Endrin	0.10	4.0
115. Endosulfan II	0.10	4.0
116. 4,4'-DDD	0.10	4.0
117. Endrin Aldehyde	0.10	4.0
118. Endosulfan Sulfate	0.10	4.0
119. 4,4'-DDT	0.10	4.0
120. Endrin Ketone	0.10	4.0
121. Methoxylchlor	0.5	20.0
122. Chlordane	0.5	20.0
123. Toxaphen	1.0	40.0
124. AROCLOR-1016	0.5	20.0
125. AROCLOR-1221	0.5	20.0
126. AROCLOR-1232	0.5	20.0
127. AROCLOR-1242	0.5	20.0
128. AROCLOR-1248	0.5	20.0
129. AROCLOR-1254	1.0	40.0
130. AROCLOR-1260	1.0	40.0

^e Medium Water Contract Required Detection Limits (CRDL) for Semi-Volatile HSL Compounds are 100 times the individual Low Water CRDL.

^f Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Semi-Volatile HSL Compounds are 60 times the individual Low Soil/Sediment CRDL.

* Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the contract, will be higher.

** Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

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Table 1-4

Elements Determined by Inductively Coupled
Plasma Emission or Atomic Absorption Spectroscopy

<u>Element</u>	<u>Contract Required Detection Level (ug/l)</u>
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	5
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Tin	40
Vanadium	50
Zinc	20

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fuel oil. From a health standpoint, this oil is classified as slightly toxic from an inhalation standpoint and moderately toxic from an ingestion or absorption standpoint (Todd, 1984). Orally, these oils are significantly toxic to humans and, in particular, to children when ingested in pure form. Diesel fuels are also recognized carcinogens. In its unweathered form, this oil is usually a brown, slightly viscous liquid that is quite volatile (OHS Hazardline).

When used for wood treatment, this oil may contain up to five percent PCP along with impurities such as lesser chlorinated phenolics, polynuclear aromatic hydrocarbons (PAH), chlorinated dibenzofurans, and various dioxin isomers. PCP in its pure form appears as dark-colored flakes and sublimed needle crystals with a very characteristic pungent odor. PCP can also appear as a white powder and is highly toxic. Chlorinated phenolics can occur as crystals or as a brown liquid that has a characteristic phenolic odor. Chlorinated phenols can be highly toxic in organic solvents. Dioxin is a colorless, crystallized solid that will decompose when exposed to ultraviolet light and is extremely toxic and a known carcinogen. Dibenzofurans are also colorless crystals in their pure form; however, toxicity data on these chemicals are still unknown at this time (OHS Hazardline).

During the period of PCP/oil use, another mixture consisting of mineral spirits and PCP was also occasionally used. Mineral spirits are generally a clear, colorless, nonfluorescent liquid that is highly volatile. Mineral spirits are also a moderately toxic substance; however, their greatest hazard is their volatility when exposed to heat or flame. In 1977-1978, the PCP

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oil mix and the PCP mineral spirit mix was discontinued and replaced with newer water-soluble chemicals.

1.1.3.3.2 Tantalithe (Fluoro Chrome Arsenate Phenol) - Fluoro Chrome Arsenate Phenol (FCAP), which was used during the facility's early operational years, is a water-soluble salt. FCAP is a trace metal salt of phenol and is classified as a highly toxic compound. Though not specifically listed by the U. S. Environmental Protection Agency (EPA), there is significant evidence demonstrating that exposure to arsenic dusts and aerosols can cause cancer. Chrome, which is another heavy metal present in the salt, is also carcinogenic in its hexavalent form. Fluoride, a common element, is highly reactive and toxic in some forms but is not carcinogenic. All of these chemicals were mixed by NWP employees on-site to make up the Tantalithe treating solution. It is also possible that once this solution enters the environment, some dissociation might occur which could produce arsenic, chrome or fluorine compounds in addition to free phenol which are water soluble and could leach or migrate. (Todd, 1984)..

1.1.3.3.3 Chromated Copper Arsenate (CCA) - CCA is a common salt solution that has been used for wood treatment at NWP since approximately the mid-1970's. The same questions regarding the carcinogenicity of arsenic and hexavalent chrome, both heavy metals, apply to this salt complex. While there is no direct evidence that the salt is carcinogenic, it is clear that the two components, if they dissociate either in the environment or systemically, could be potential carcinogens. In contrast to FCAP, this material was bought as a premixed water concentrate. The other constituent of this salt, copper, is considerably less toxic than the other two trace metals and is of much less concern from a health or ecological standpoint. Copper is not considered

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to be carcinogenic and is normally found in all water sources at low levels (Todd, 1984).

1.1.3.3.4 Chromated Zinc Chloride (CZC) - CZC is a water-soluble salt that is used exclusively for fire-retardant treatment of wood such as flooring, paneling, and plywood. It is not useful for preservation where ground contact is expected. The constituents of this salt are chromium and zinc, which are heavy metals, and chlorine, which is an element commonly found in water. The potential adverse health impact of this salt complex used as a dilute water solution is limited to the chromium molecule which has previously been discussed. Zinc is considered an essential element and is a constituent of body fluid, although extremely high concentrations of zinc have been shown to cause some health impacts on humans and animals. This salt complex is listed as a carcinogen due to the chromium constituent (Todd, 1984).

1.1.3.3.5 Tri-Butyl Tin Oxide (TBTO) - This treatment chemical is used to a very limited extent at NWP by dilution in mineral spirits as received by tank truck and is only applied by pressure treatment. There are very few wood-treatment plants in the United States that currently use this compound for preservation purposes. The organo-tin compounds, including TBTO, have been used for years as polymer stabilizers for plastics, catalysts for chemical reactions, and for specialized paint applications, the latter specifically in anti-fouling final coating application to the hulls of ships operating in saltwater. These tin compounds are highly toxic to marine organisms and effectively prevent their growth on the ship hulls.

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Data concerning animals and humans indicate that this tin compound is moderately toxic by ingestion or inhalation. There is currently no data to indicate that TBTO or its related compounds are carcinogenic, but this topic has not been extensively studied due to its limited commercial use (Todd, 1984).

Out of all the potential contaminating products once used or in current use at NWP, it appears that the PCP oil mix and PCP mineral spirit mix pose the greatest potential problem. PCP and its various by-products and impurities have been detected in soils and water at NWP and could pose a threat to the environment.

1.1.3.4 Actions Responsible for Discharges of Chemicals to the Environment at the Havertown PCP Site - Wood-treatment chemicals impregnated in wood do not pose a community health problem when applied commercially. With care in handling these toxic materials, along with good work practices and waste handling procedures, they can be used without health risk to the plant worker, consumer, and the population living adjacent to the facility. Unfortunately, treatment plant owners and management have not always considered aesthetic, ecological, or health impacts caused by the improper use or handling of these chemicals, which very slowly disperse or degrade in the soil or water environments. The State has conducted inspections of the NWP facility as far back as 1956, and during that time, requests for remedial efforts to improve housekeeping and control chemical spills were often presented to the former owner; however, little was actually done until 1963 when the new owners took control of the operations (Todd, 1984).

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The basic plant layout--including the pressure treatment cylinders, the dip tank, and the bulk storage facilities--is essentially the same as when first installed in 1947. The exception is the dry chemical-mixing facilities for FCAP, which are no longer used for this purpose, but instead are now used for direct solvent or water dilution of some of the present treatment materials. In 1963, after purchase of the plant by the Goldsteins, and at the request of the State, some plant processing and other modifications were completed. These modifications included the construction of concrete sumps at the ends of each of the two large pressure treatment cylinders in the main building and the treatment cylinder located outside for recycling of any unused solution. In addition, modifications were made to pumps and piping equipment and to storage tanks and the pressure cylinders to eliminate leak sources to the soil or air. Presently, all the wood-treatment materials are recycled, with the exception of sawdust and other debris, which are generated in the pressure treatment cylinders from the processed wood. These materials are occasionally cleaned out of the pressure treatment cylinders and drummed for off-site disposal at an EPA-approved facility (Todd, 1984).

The presence of PCP and oil in both groundwater and soil samples collected at the Havertown PCP site indicates that discharges to the environment have occurred at this facility in the past. Prior to 1963 and before the modifications mentioned above, leaks and spills in the wood-treatment equipment, plumbing, and storage facilities would have been one source of contaminants to the environment. It is not certain how major a source this would have been; however, due to the lack of concrete containment basins prior to 1963, and poor maintenance at the site as reported by the State, any leak or spill that occurred would be
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generally have easy access to the soils and subsequently the groundwater and surface water.

Another potential source of contaminants to the environment would occur as a result of storage of treated wood on the property. Once wood is treated at NWP, it is stored on the ground in an area west and south of the main building. This storage area is not lined in any way and is also not covered, thereby exposing the treated wood directly to the environment. While this is not so critical with the newer wood-treatment solutions, due to the wood being essentially dry after treatment, it may have been more critical during use of the PCP oil mix, which normally left the treated wood wet with this solution for some time after the treatment. The treated wood, which was saturated with this solution, was stored on-site, and the PCP oil solution could drip onto the ground or be washed onto the ground by rain. It is evident from the dark color of the ground, as shown on air photographs taken during the facility's early years, that leaks, spills, and drippage on the ground surface did occur at NWP.

The major source of contamination to the environment from 1947 to 1963 at NWP probably occurred through the use of an injection or disposal well to get rid of spent wood-treating solutions. This well, which was not used by the current owners, was reported to be located somewhere in the vicinity of what is now known as Young's Produce Market on the intersection of Eagle and Lawrence Roads. It is estimated that up to one million gallons of spent solution may have been disposed of by this method from 1947 to 1963. During this period, the spent solution would have consisted primarily of PCP dissolved in oil. This uncontrolled

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disposal method would have resulted in significant contamination of the groundwater surrounding the site.

Since 1963, the primary means responsible for discharge of contaminants to the environment has most likely been accidental spills and leaks in the tanks or plumbing systems. It is believed, however, that the majority of contaminant discharges to the environment occurred prior to 1963.

1.1.3.5 Havertown PCP Site Chronology - Many dates, as well as additional studies, are important in order to better understand the nature, extent, and cause of contamination at the Havertown PCP site. The following site chronology, which lists important dates concerning the site, as well as previous investigations conducted to date for determining the nature and extent of contamination at the site, was compiled from DER and REWAI files.

- o December 7, 1947: PCG purchases the property located across Eagle Road from NWP and has been engaged in the manufacture of chewing gum products.
- o 1947: NWP was incorporated by Samuel T. Jacoby. The property on which the plant conducts its business was leased from Clifford and Virginia Rogers.
- o 1947-1963: It was during this period that the NWP facility, operated by Mr. Jacoby, in Haverford Township, Pennsylvania, allegedly disposed of wood-treatment waste materials into a 25- to 35-foot-deep well, which was said to be located in the vicinity of what is now Young's Produce Market. These wastes generally

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consisted of spent wood-treatment solutions containing pentachlorophenol (PCP) and oil.

- o 1962: The Pennsylvania Department of Health became aware of contamination in Naylor's Run and linked the source to waste disposal practices at the NWP site.
- o 1963: NWP was sold by Samuel Jacoby to the Goldsteins with the property still being owned by Mr. Clifford Rogers, who leased it to the Goldsteins. The Goldsteins discontinued use of the well for disposal practices when they took over the operations.
- o October 14, 1964: The Commonwealth of Pennsylvania versus Samuel T. Jacoby - Mr. Jacoby was found not guilty for previous waste disposal activities at the Havertown PCP site because the State had not complied with provisions of Section 309 (Act 3, 1945).
- o December 31, 1964: An agreement was signed between the Goldsteins and Samuel Jacoby which released Mr. Jacoby from responsibility for the pollution.
- o February 10, 1967: Shell Oil Company obtained a leasehold interest for the portion of Clifford and Virginia Rogers' property located at the northwest corner of Eagle Road and Lawrence Road. Shell developed this portion of the Rogers' property and constructed a gasoline station at this location.

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- o Spring 1972: PCG excavated part of its property in order to construct an addition to its building. During the course of excavation, an oily pollutant was discovered in the ground underlying their property.
- o 1972: DER received complaints from local citizens concerning an oily substance being discharged into Naylors Run. DER investigated and identified contaminated groundwater discharging from a storm sewer into Naylors Run just east of PCG. DER order NWP and Clifford A. Rogers to conduct a cleanup; however, the cleanup was never undertaken.
- o June 12, 1972: An initial inspection was attempted at PCG by DER at the request of the health officer for the Haverford Township Board of Health; however, site access was denied by the company president, who requested that DER return on another date with an appointment.
- o June 13, 1972: DER returned to PCG with a search warrant, which was served to Mr. J. Daily, Executive Vice President of PCG. Mr. Daily accompanied DER during their visit. Samples collected by DER were analyzed by DER laboratories in Harrisburg.
- o June 15, 1972: PCG submitted a report from Site Engineers, Inc. of Morristown, New Jersey. The report considered the cause and source of pollution entering Naylors Run behind PCG property.

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- o September 22, 1972: A conference was held between PCG and DER in DER's Norristown office. At this conference, DER requested that a concerted effort on the part of all involved parties be carried out to clean up this site. Nothing was resolved at this meeting.
- o September 26, 1972: A test well was drilled at NWP by DER with the cooperation of PennDOT. The test well was located along the Eagle Road side of the NWP facility. Upon completion of drilling, water samples were collected and analyzed from this well. The results of this sampling showed PCP in fuel oil to be present in the well. A waste discharge inspection report was filed.
- o July 12, 1973: DER issued an order to NWP, PCG, and the Shell Oil Company to take concerted action to correct the pollution condition that existed on lands occupied by them.
- o September 12, 1973: DER issued an order to Clifford A. Rogers and Virginia M. Rogers, owners of the properties where NWP and Shell Oil Company are situated, to take concerted action to correct a pollution condition which exists on their land.
- o October 17, 1973: A technical review on the pollution situation at the Havertown PCP site was produced by Ralph V. Zampagna, a geologist from EPA's Groundwater Section Strike Force.

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- o November 1, 1973: Timely appeals by concerned parties, from the orders issued on July 12, 1973 and September 12, 1973, were filed with the Environmental Hearing Board, which by order of November 1, 1973, consolidated all of the appeals for hearing.
- o January 23, 1974: An inspection was made and samples were collected at NWP by DER.
- o March 24-25, 1975: A 24-hour stream bioassay was conducted on Naylor's Run, the purpose of which was to determine whether toxic concentrations of PCP were present in the stream.
- o September 10, 1976: DER contacted EPA Region III Environmental Emergency Branch and requested assistance with the continuing oil seepage problem in Naylor's Run.
- o September 15, 1976: Representatives of EPA and DER conducted a joint inspection of the area and observed oil discharging at two locations near the headwaters of Naylor's Run.
- o September 17, 1976: EPA declared a Federal Removal Activity for cleanup activities under Section 311 of the Clean Water Act. Cleanup was initiated with installation of filter fences in Naylor's Run to remove surface contamination.

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- o 1976: The EPA Region III Emergency Response Team began cleanup procedures of the area surrounding the NWP facility. A mobile physical-chemical treatment system and mobile spills laboratory were moved to the site. Successful cleanup of the effluents was reportedly accomplished; however, contaminated groundwater continued to leach out. Two sewer pipes, from which contamination was emanating, were reportedly grouted shut. The sanitary sewer was reported to be successfully sealed; however, contaminated effluent still discharges from the storm sewer.
- o October 15, 1976: The Pennsylvania Commonwealth Court granted the landowners and occupiers a supersedeas from the November 1, 1973 order pending the outcome of the appeals.
- o November 1-2, 1976: EPA had three recovery wells constructed at NWP by Rulon and Cook, Inc., general drilling contractors, who were subcontracted by Underwater Technics, Inc. The purpose of the wells was to allow pumping of the PCP oil mix to the surface for treatment, after which the treated fluid would be returned to Naylor's Run.
- o November 17, 1976: DER personnel conducted a field investigation at Naylor's Run and filed a report concerning the visit on December 8, 1976.
- o December 17, 1976: The Environmental Emergency Response Unit operations were secured after it was determined

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that oil recovery from wells and trenches was not as successful as originally anticipated.

- o December 1976: Underwater Technics, Inc. was retained for maintaining filter fences and storing and disposing of waste.
- o February 16, 1977: A meeting was held between DER, EPA, and Underwater Technics to discuss the progress in preventing further discharges to Naylor's Run. A 20-foot-deep, 3-foot diameter steel corrugated pipe was placed in the ground behind PCG property to intercept the two small pipes which were carrying the PCP oil to the Washington Avenue discharge point.
- o August 12, 1977: Underwater Technics, Inc. completed the grouting of the 36-inch storm drain.
- o October 7, 1977: EPA Haverford Spill Incident Report concerning methods used and results obtained for the analysis of samples collected from the Havertown site.
- o February 20, 1978: A report entitled "Laboratory Feasibility and Pilot Plant Studies on Naval Biodegradation Processes for the Ultimate Disposal of Spilled Hazardous Materials" was submitted to EPA by Atlantic Research Corporation. In this study, two pilot-scale batch tests were performed using organism 044 and PCP. The tests were performed in order to evaluate sodium oxide as a potential bacterio-static agent.

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- o April 20, 1978: Atlantic Research Corporation, under contract to EPA's Oil and Hazardous Materials Spill Branch, conducted preliminary experiments to assess the feasibility of using selected pure cultures to treat the PCP oil contaminated area in Havertown, Pennsylvania. The results of these experiments were submitted in a report entitled, "Microbiological Treatment of Soil Contaminated with Pentachlorophenol/Oil from the Haverford, Pennsylvania Spill Site."
- o May 24, 1978: After five years of litigation, Commonwealth Court sustained appeals of Shell Oil Company and PCG and ordered the cleanup to be executed solely by the Rogers' and NWP.
- o August 30, 1978: An aquatic biology investigation was conducted on Cobbs Creek and its tributaries, one of which is Naylor's Run, to determine the extent of water quality.
- o October 1980: The U. S. Supreme Court refused to hear an appeal by NWP and the Rogers', claiming that the State had abused its authority in ordering NWP to clean up Naylor's Run, as NWP believed the contamination occurred prior to their ownership of the business.
- o December 1980: The U. S. Coast Guard Third District issued a request for proposal to study the extent of contamination and recovery feasibility for the PCP and oil in Naylor's Run. The scope of work was proposed under Section 311 of the Clean Water Act.

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- o December 16, 1980: The cleanup proposal submitted by NWP was deemed inadequate and NWP was instructed by DER to prepare a more comprehensive proposal.
- o January 23, 1981: A plan for monitoring wells was sent to NWP by Mr. James Humphreville, geologic consultant. These monitoring wells were to serve as observation points for determining the lateral extent and thickness of oil floating on the groundwater surface.
- o February 12, 1981: The EPA OSC served NWP with a Notice of Federal Interest in a pollution incident connected with the release of waste oil contaminated by PCP into Naylor's Run. The letter directed NWP to initiate studies to determine the extent of contamination and recovery feasibility of the contaminant. In addition, NWP was directed to take over the maintenance of the filter fences placed in Naylor's Run.
- o February 25, 1981: Sampling was carried out by Ecology and Environment, Inc. (E & E), a consulting firm from Buffalo, New York, contracted by EPA to provide technical assistance for the cleanup of soil and hazardous material spills.
- o February 26, 1981: NWP refused to comply with the OSC's directions issued February 12, 1981.
- o February 1981: The Technical Assistance Team conducted an inventory of drums from the Naylor's Run cleanup which were stored at Underwater Technics' storage yard. This

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inventory was conducted in preparation for disposal of the drums at Rollins Environmental Services.

- o March 1981: The consulting engineering firm of SMC-Martin, Inc., King of Prussia, Pennsylvania, was awarded the EPA contract for an extent of contamination and recovery feasibility study for the PCP oil contamination problem in Naylor's Run.
- o April 1981: Preliminary work began on the PCP oil project by SMC-Martin, Inc.
- o May 13, 1981: Mr. James Humphreville, geologic consultant, was contracted by NWP to conduct an extent of contamination study on NWP and the Rogers' property.
- o May 19, 1981: The Environmental Response Team collected air samples in the area surrounding NWP. One to two liters of air was collected at four different locations.
- o June 10, 1981: The Environmental Response Team conducted a biological survey at the site. This study showed that no benthic aquatic life existed up to a distance of one-half mile downstream from the contamination entry points into Naylor's Run. During the study, workers exposed to the vapor emanating from the storm drain while standing on adjacent private property suffered irritation to eyes, skin, and mucous membranes.

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- o June 25-26, 1981: The Environmental Response Team collected a second round of air samples around NWP at the same four locations sampled May 18, 1981.
- o July 27-30, 1981: The SMC Martin, Inc., monitoring well network was drilled. A total of 10 shallow monitoring wells, referred to as HAV-01 through HAV-10, were installed on PCG property and on residential properties along Rittenhouse Circle.
- o October 26, 1981: Procurement requested by EPA for removal of PCP oil from Naylor's Run.
- o November 4-6, 1981: Five observation wells were drilled by Thomas G. Keyes, Inc., on the Clifford A. Rogers Estate. Six observation wells were drilled on NWP property.
- o November 5, 1981: Statement of work issued for construction of filter fences in Naylor's Run.
- o September 11, 1981: Contaminated soil from the drilling project was disposed of at GROWS Landfill in Morrisville, Pennsylvania. Liquid wastes and contaminated debris from Naylor's Run were disposed of by Rollins Environmental Services of Bridgeport, New Jersey. This disposal was accomplished by incineration.
- o December 18, 1981: CERCLA notice letter sent to NWP to maintain in-stream filter fences in Naylor's Run. NWP

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agreed to do this and EPA began terminating its containment operations.

- o January 1982: SMC Martin, Inc. report "Assessment of Groundwater Contamination by Pentachlorophenol, Naylor's Run and Vicinity, Haverford Township, Delaware County, PA" prepared for the United States Coast Guard-Contract #DTCG26-81-C-00136.
- o January 31, 1982: EPA ended containment operations in Naylor's Run, thus terminating Section 311 funding activities.
- o February 1, 1982: NWP assumed responsibility and maintenance of the containment operations in Naylor's Run as a result of negotiations following receipt of a CERCLA notice letter dated December 18, 1981.
- o February 5, 1982: James Humphreville report of NWP site sent to Donald Goldstein.
- o March 24, 1982: A public information meeting was held at the Lynnewood School regarding efforts of the EPA and the DER to assess and deal with hazards posed by the release of wood-treatment chemicals in the vicinity of Naylor's Run.
- o April 15, 1982: The Emergency Response Team performed a site visit and environmental sampling effort at the NWP site. Samples of air, water, stream sediment, and biota were obtained.

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- o June 1982: The on-scene coordinator (OSC) requested that the Center for Disease Control make a final evaluation of any significant risk or harm to human life, health, or to the environment related to the site.
- o June 1982: At EPA's recommendation, NWP posted warning signs along Naylor's Run.
- o July 6, 1982: EPA letter to DER requesting a written statement of position regarding a comprehensive cleanup plan.
- o July 21, 1982: Hazard Ranking System Model was submitted to EPA by Ecology and Environment, Inc., Field Investigation Team (FIT).
- o August 11-17, 1982: Air sampling performed by the Technical Assistance Team at Havertown PCP site.
- o October 5, 1982: The Center for Disease Control responded to the request made by OSC in June 1982 with a memo consisting of additional questions and inquiries for information.
- o December 1982: The Havertown PCP site, consisting of the NWP plant, was placed on the National Priorities List.
- o September 1983: EPA sent a copy of the draft "Remedial Action Master Plan" to DER for their evaluation and comments.

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- April 13, 1984: DER letter to EPA concerning upgrading filter fences, limiting access to hazardous areas, and placing more permanent warning signs downstream along Naylor's Run.
- o April 25, 1984: Letter from Representative R. W. Edgar to the Community Relations Office DER requesting that DER show its concern for the health and welfare of the Havertown community and rapidly proceed with cleanup operations.
- o May 17, 1984: Stewart-Todd Associates report for Haverford Township completed. This report consisted of an evaluation of the NWP facility and hazards to the community and environment surrounding the NWP site.
- o May 30, 1984: EPA representative noted during a site visit that the filter fences were not operating properly and would have to be reconstructed.
- o June 1, 1984: DER initial report on cleanup efforts sent to area residents. Counsel for NWP agreed that it was their client's responsibility to maintain the filter fences.
- o June 12, 1984: EPA's representative met with a representative of NWP at the site to discuss, in full detail, the reconstruction and maintenance of the filter fences. Shortly thereafter, NWP informed EPA that it had reconstructed the fences.

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- o September 12, 1984: DER conducted an inspection at the site. The filter fences were clogged; one fence was partially missing; and another was disconnected at one end.
- o October 3, 1984: EPA conducted an investigation. Again the filter fences were clogged and in a state of disrepair.
- o October 10, 1984: EPA issued a unilateral order pursuant to Section 106 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C. 9606 to NWP for proper reconstruction and maintenance of existing filter fences.
- o January 25, 1985: DER regional press release announcing a public meeting for area residents on February 26, 1985.
- o February 1985: DER completes a draft "Community Relations Plan for Remedial Action at the Havertown PCP Site."
- o February 26, 1985: Public meeting with DER and area residents concerning cleanup effort at the Havertown PCP site.
- o April 17, 1985: EPA site inspection of NWP site. Filter fences saturated and broken.

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- o April 26, 1985: EPA site inspection of NWP site. Oil still seeping through repaired filter fences. NWP's senior owner expressed his unwillingness to do maintenance more than once daily.
- o November 26, 1985: Department of Health and Human Services memorandum stating their opinion that the PCP concentration in the water (at the site) does not present any human health hazard.
- o December 12, 1985: CERCLA toxicologist report to EPA stating that hexachlorinated dibenzodioxin present in the PCP was "not of trival concentrations or risk levels."
- o July 8, 1986: DER (central office) information and update letter sent to DER Norristown regional office.
- o September 16, 1986: RI/FS contract signed between DER and REWAI.
- o February 13, 1987: Delay in DER receiving signed access agreements; notice to proceed is extended.
- o February 26, 1987: DER mails letter to area residents providing notice of a public meeting to be held on March 12, 1987.
- o (Date Uncertain): DER sends a consent for right-of-entry form to Conrail, pursuant to a previous telephone conversation.

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- o March 10, 1987: On-site meeting by DER and REWAI to prepare for public meeting to be held on March 12, 1987.
- o March 12, 1987: Public meeting to discuss access agreements for the Havertown project.
- o March 19, 1987: DER again issues an extension of the notice to proceed to REWAI.
- o April 2, 1987: DER distributes simplified right-of-entry consent forms to area residents.
- o May 29, 1987: DER and REWAI meet to discuss the Havertown project. The written notice-to-proceed documents were hand delivered, with the official project start-up stated for June 1, 1987.
- o June 1, 1987: Official start date of Havertown PCP site RI/FS project.
- o June 4, 1987: REWAI conducts initial site visit and inspection.
- o June 8, 1987: REWAI receives written comments from DER/EPA concerning the Health and Safety Plan (HASP) and the Site Emergency and Contingency Plan (SECP). REWAI completes the initial site inspection.

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- o June 9, 1987: DER, REWAI, Empire Drilling, Penoni Associates (township engineers), and various utility representatives meet on-site to plan fieldwork.
- o June 16, 1987: Gary Moulder (DER) receives notice from Lorna Shull (EPA) that "extensive analysis for dioxin isomers and dibenzofurans will be necessary" at the Havertown PCP site.
- o June 28-30, 1987: U. S. Testing Corporation, subcontractor to REWAI, conducts initial on-site air sampling for the Havertown PCP site RI/FS.
- o July 13-July 31, 1987: REWAI conducted the preliminary sampling investigation at the Havertown PCP site during this three-week period. Work included mobilization of equipment to the site and setup of a support zone and decontamination area for future RI/FS work.
- o November 10-11, 1987: REWAI conducted a site visit, the purpose of which was to collect a sample from the 2,000-gallon polyethylene wastewater storage tank, which contained water and product from the preliminary groundwater sampling conducted in July. This sample was collected so that a full priority pollutant scan could be run. In addition to collecting this sample, a complete round of static groundwater level measurements and product thickness measurements was conducted on all existing wells.

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- o December 3, 1987: DER received lab reports confirming the presence of dioxin in on-site soils, seven of which exceed EPA action levels.
- o December 4, 1987: Meeting between DER, EPA, Pennsylvania Health Department, and U. S. Health Department on possible health impacts to the community.
- o December 9, 1987: On-site press conference by DER/EPA and a tour of Naylor's Run Creek.
- o December 10 and 11, 1987: Door-to-door contact of area residents was made by DER and EPA to obtain permission to sample residential properties.
- o December 12, 14, and 16, 1987: DER and EPA conducted joint sampling of off-site residences and businesses. A total of 59 soil samples were sent to the DER lab in Harrisburg for analysis. EPA began emergency response measures at the site.
- o December 21, 1987: Preliminary sample results indicated no detection of PCP in any residential soil samples collected off-site. PCP was detected in the drainage swale and on one spot at Continental Auto.
- o December 28, 1987: EPA completed initial work on the underflow dam at the outfall of Naylor's Run.
- o January 18-February 26, 1988: REWAI coordinated and supervised the installation of 6 cluster wells (3 wells per cluster, for 18 total monitoring wells) with AR300064

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Soils Investigations, Inc. of Highland Park, New Jersey, serving as the subcontracted drillers. These wells were installed to aid in determining the extent and nature of contamination at the Havertown PCP site, and to aid in understanding the hydrogeology of the site.

- o February 28-March 17, 1988: REWAI developed all newly installed monitoring wells and conducted slug tests on all newly installed wells to determine the permeability of the hydrogeologic units underlying the site.
- o March 14-18, 1988: USTC performed second round of air quality sampling.
- o March 7-18, 1988: REWAI conducted groundwater sampling of all 18 newly installed and 10 selected existing monitoring wells.
- o March 30-April 1, 1988: USTC conducted third and final air quality sampling round.
- o April 11, 1988: REWAI conducted a site visit to collect a sample of the oil for specific gravity measurement and to measure static groundwater levels and oil thickness in all site wells.

1.2 Nature and Extent of Contamination

1.2.1 Types and Quantities of Wastes Produced by Plant Operations

The primary constituents of concern that occurred as a result of wood-treatment operations at NWP in Havertown are PCP, 12280065

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chlorinated dioxin and dibenzofurans, fuel oil and mineral spirits components, heavy metals, certain volatile organic compounds, and phenols. These materials are all primary constituents or impurities of the various wood-treatment solutions used at NWP since operation began in 1947. Any potential breakdown products of these wood-treatment chemicals also warrant concern, which is why the entire HSL was analyzed.

The constituents of concern at the Havertown PCP site are generally found adsorbed on solid particulates or dust in the soils on-site, and in solution in site groundwater and surface water, as well as in the oil that is known to exist on the groundwater surface beneath the site. The existence of this oil layer is demonstrated by monitoring wells installed by previous studies, as well as the presence of oil in Naylors Run.

The contaminants at the Havertown PCP site entered the environment initially through accidental spills and leaks to the soil, and through disposal of spent solutions into a 25- to 35-foot-deep disposal well located on-site. The latter method, which was not believed to have been used by the new owners, is probably responsible for the greater portion of the site's contamination, and it is estimated by previous investigators that as much as one million gallons of spent preservatives may have been disposed of in the well. Although improvements have been made to the wood-treatment equipment (i.e. catch basins) since 1963, it is likely that some quantity of wood-treatment chemicals has either leaked to the ground or leached out of treated wood that is stored uncovered on-site for customer pickup. Unfortunately, it is nearly impossible to determine precisely how much solution has spilled, leaked, or been disposed of on-site;

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therefore, several investigations, including this one, have been conducted to determine the nature and extent of the contamination problem at the Havertown PCP site.

1.2.1.1 Summary of Previous Investigations to Determine the Nature and Extent of Contamination at the Havertown PCP Site - Invasive investigative studies have been previously conducted at the Havertown PCP site in an attempt to determine the nature and extent of contaminant concentrations in the groundwater at the site. The following is a brief summary of those investigations.

- o Assessment of Groundwater Contaminated by Pentachlorophenol; Naylor's Run and Vicinity, Haverford Township, Delaware County, Pennsylvania- SMC Martin, Inc., 1982.

This report provides a general geologic description of the shallow subsurface, information pertaining to groundwater hydrology, and details concerning the extent of contamination at the Havertown PCP site.

In 1980, the United States Coast Guard 3rd District prepared a Request for Proposals (RFP) for the first stage of a long-term recovery program for the Havertown PCP site. The project was to consist of an assessment of the extent of contamination at the site, an estimate of the quantity of oil/PCP present in the groundwater, and a discussion of various recovery and treatment schemes for the contamination. That contract was awarded to SMC Martin, Inc. in 1981.

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SMC Martin designed a monitoring well network which was to provide documentation on the extent of contamination in the area and determine the direction of groundwater and contaminant movement. The SMC Martin monitoring well network consisted of 10 wells, referred to as HAV-01 to HAV-10, which were drilled and constructed using a truck-mounted hollow-stem auger drill rig. Wells HAV-01 to HAV-03 were located on the front portion of PCG property to detect contamination emanating from NWP property, and wells HAV-04 to HAV-10 were drilled on the rear portion of residents' properties in the Rittenhouse Circle area to determine contaminant extent and whether any oil migrated beyond the storm sewer. Because a consultant for NWP, Mr. James Humphreville, was supervising the drilling of a monitoring well network on NWP property during this same time period, SMC Martin decided against drilling on NWP property to avoid duplication of effort. The SMC Martin wells ranged from 10 to 35 feet in depth; consisted of gravel packed, 2-inch saw-slotted PVC; and were generally set in the fill and saprolite units. Split-spoon sampling, for the purpose of geologically logging each boring, was conducted by SMC Martin, with samples being collected approximately every five feet.

The following are SMC Martin's major findings and conclusions from their Havertown hydrogeologic study:

- . Groundwater at the site occurs primarily in the saprolite or weathered mantle of the Wissahickon schist under unconfined or water table conditions.
- . The bedrock surface, while not cored, was presumed to be highly irregular due to varying degrees of

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weathering and, because of this irregularity, could affect groundwater flow and contaminant migration.

- . Groundwater flow beneath the site was primarily to the east with eventual discharge to Naylor's Run, and the hydraulic gradient was found relatively constant except for an anomalously low gradient area just east of NWP. It was believed that the nature of the fill in this area could be the cause of this low gradient.
- . Eight monitoring wells (HAV-01, HAV-02, HAV-04, NW-4-81, NW-5-81, NW-3, R-2, and R-3) contained measurable oil thicknesses, with well R-2 containing the greatest thickness at 5.60 feet. The contaminant oil plume was projected as being elliptical in shape, centered approximately around R-2, with its major axis parallel to the principal groundwater flow direction.
- . The area contaminated by measurable free oil on the groundwater surface was estimated to encompass approximately 4.5 acres.
- . The estimated volume of free oil present on the water table surface was 400,000 to 650,000 gallons.
- . The storm sewer behind PCG property was believed to act as a conduit for oil migration, and because of that, oil did not appear to migrate past the storm sewer trench.

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- o Groundwater Contour Map and Oil Thickness Isopach Map -
James A. Humphreville, 1981-1982

In late 1981, Mr. Humphreville arranged the drilling and construction of 11 monitoring wells on NWP property in order to determine the extent of oil/PCP contamination on-site and to develop plans to recover the contaminant. These monitoring wells are referred to as NW-1-81 to NW-6-81 and R-1 to R-5. The wells were drilled using a pneumatic rotary drill rig, ranged in depth from approximately 24 feet to 36 feet, and are generally set in saprolite and/or fill. Mr. Humphreville measured oil thicknesses in the wells and reported numbers very similar to those reported by SMC Martin. He included in this report an oil isopach thickness map for NWP property which displays an elongated oil plume trending in an easterly direction from NWP property and centered around wells NW-5-81 and R-2.

Mr. Humphreville also includes a groundwater table contour map with water table elevations corrected for an assumed oil-specific gravity of 0.794. This map shows an easterly-southeasterly groundwater flow direction with water moving from NWP property toward PCG property.

In addition to the above, Mr. Humphreville calculated the volume of free recoverable oil present to be 157,600 gallons with an additional 143,400 gallons being tied up in the unsaturated zone.

Finally, Mr. Humphreville discussed the installation of a proposed oil recovery well located close to monitoring well R-2

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in which he recommended that a recovery pump be placed to recover free product.

o Previous Environmental Samplings at the Havertown PCP Site

Since approximately 1970, numerous groundwater, surface water, soil, biota, and air samples have been collected from the Havertown PCP site and analyzed. These samples have been collected and analyzed by DER, the Pennsylvania Department of Health (PDH), EPA, and private consultants.

For the most part, air samples have not indicated significant contamination. However, benzene was detected at 0.5 ppm in a 1981 survey; and xylene (1.97 ppm), mineral spirits (7.19 ppm), and PCP (up to 3.7 ug/m³) were detected in a 1982 survey (NUS, 1983).

In 1972, DER collected two soil samples from drill cuttings, which were analyzed and showed fuel oil and an estimated 1,000 ppm PCP. EPA collected soil samples from the streambed sediment of Naylor's Run in 1982 and discovered they contained 3.4 ppm PCP (NUS, 1983).

Groundwater was sampled numerous times by DER in 1972, 1976, and 1982. In 1972, fuel oil, PCP, and naphtha were determined to be present, and in the later samplings, PCP was again determined to be present (up to 21.6 ppm). An oil sample collected by DER from the groundwater table surface contained PCP concentrations up to 31,200 ppm (NUS, 1983).

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Finally, numerous surface water samples have been collected and analyzed by different groups since the early 1960's, and the majority of these samplings have indicated the presence of PCP in the water of Naylor's Run (NUS, 1983).

1.2.2 Effects of Contaminants from Wood-Treatment Operations on the Area Surrounding NWP

1.2.2.1 Types of Contaminants Releases Affecting the Area Surrounding NWP - The most significant release of wood-treatment chemicals and solutions to the environment at NWP occurred as a result of disposal of these spent solutions in a 25- to 35-foot disposal well, which was reported to be located somewhere in the vicinity of what is now Young's Produce Market. During the wood-treatment process, it is common to have some wood-treatment solution left in the treatment vessels upon completion of the treatment process. Prior to 1963, this remaining solution was not generally recycled, and instead of sending the solution off-site for disposal, the owners disposed of it in this shallow well. The major wood-treatment solution disposed of in this manner was PCP dissolved in fuel oil. This shallow disposal well provided an easy and rapid avenue for these contaminants to enter the groundwater system and eventually reach surface waters where the groundwater discharges. It is not precisely known how much solution may have been disposed of in this manner; however, it is estimated that up to one million gallons were disposed of from 1947 to 1963 (NUS, 1983). When the new owners commenced operations in 1963, this disposal method was reportedly discontinued and the operations were upgraded to allow for recycling of treatment solutions and containment of spills and leakage.

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It was also reported by other investigators (SMC Martin 1982, Fountain et al, 1975) that wood-treatment pits and facilities, which were at one time used, may have allowed the PCP/oil solution to infiltrate the surface soils and eventually reach the saturated zone. Once these treatment solutions are "spilled" in the soils, their chemical constituents and breakdown products can also be spread to the environment surrounding NWP by becoming entrained in the wind along with dust.

A third means of introducing contaminants to the surrounding environment occurs as a result of accidental spills and leakage which are common to most industrial operations. The NWP site contains numerous above-ground storage tanks and a network of above- and underground plumbing. Prior to 1963, much of this was reported to be in need of repair and updating. The new owners, at the request of DER, updated much of the plumbing and installed concrete catch basins around the treatment vessels, which should aid in preventing accidental spills and leaks in reaching the underlying soils. However, prior to 1963 and even to some degree after 1963, accidental spills and leakage potentially provided a means for wood-treatment solutions to enter site soils and subsequently the groundwater and surface water systems.

A final means of introducing these materials to the environment occurs as a result of treated raw materials storage piles. Once the wood has been treated, it is stored uncovered, outside on the ground surface until pickup by the client. When the PCP/oil solution was used for treatment, the wood was still wet after the treatment was completed and the excess PCP/oil mixture would drip on the ground surface during transport to its storage site and once at its storage location. Old aerial photographs show the ground surface of NWP to be very dark in color, which could be a

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result of this drippage. Even the newer wood-treatment chemicals can enter the environment at wood storage locations due to their water-soluble nature, which can cause them to leach out of the wood and be disposed on the underlying soil with the aid of precipitation.

All of these release mechanisms initially affect a small on-site area, but through different modes of transport and movement, they can end up affecting much larger areas off-site.

1.2.2.2 Media Affected by Contaminants at the Havertown PCP Site - Probably the most obviously affected media potentially threatening the general public at the Havertown PCP site are the surface waters of Naylor's Run. In an area just east of PCG where the storm sewer discharges into Naylor's Run, oil containing PCP is evident on the water's surface. A filter fence has been installed on the stream at this location to contain the oil, and a strong pungent odor is emanating from the pooled oil. Previous investigations have reported that the PCP/oil solution is entering the stream primarily from the storm sewer discharge. This oil has been documented as far as one-half mile downstream and is responsible for numerous resident complaints. The major, present-day source of PCP/oil to the stream is believed to be the large oil reserve situated on the groundwater surface beneath NWP and PCG property. This contaminant oil layer is believed to be the result of approximately 16 years of PCP/oil disposal from NWP into a shallow injection well.

Another source of contaminants from NWP property to Naylor's Run would occur as a result of surface water runoff, which was often evident during moderate to heavy precipitation events at the site. In the past, when NWP's ground surface was commonly

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covered with the PCP/oil mix, surface runoff, which eventually discharged to Naylor's Run, could have been a major source of contamination to the creek. Numerous samplings conducted to date, of Naylor's Run water, have shown significant concentrations of PCP in the water, and biological surveys and in-situ bioassays conducted in Naylor's Run have documented the presence of conditions toxic to aquatic life (NUS, 1983).

A second media which has been greatly affected by actions at NWP and possibly other adjoining properties is groundwater. Two previous invasive investigations have shown the presence of a layer of PCP/oil mixture on the groundwater surface beneath the site. The shallow injection well, which was reported to be located in the vicinity of what is now Young's Produce Market and which was used to dispose of spent wood-treating solutions, is believed to be the major source of this contaminant plume. Groundwater samples collected from monitoring wells in the vicinity of the site exhibit PCP concentrations ranging from 0.22 to 21.6 ppm and a sample of oil collected from HAV-04 exhibited a PCP concentration of 31,200 ppm (NUS, 1983). Contaminated groundwater is intercepted to some extent by Naylor's Run and the storm water sewer.

A third media affected by contaminants are the site's soils. As a result of soil samples collected and analyzed during this RI, it is evident that soils on NWP property are contaminated. Due to reasons discussed in Section 1.2.2.1 above, soils at NWP have accumulated contaminants over the many years of the plant's operation. Soil samples collected from this property during previous samplings by DER have also exhibited concentrations of PCP and fuel oil.

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Finally, air is affected by contaminants at the Havertown PCP site. As observed by REWAI, this becomes most apparent when the dried surface soils on NWP, which contain contaminants, are entrained by winds and spread across the study area. In addition to this, as previously mentioned, strong odors persist in the vicinity of Naylor's Run because of free-phase floating product on the stream's surface, and PCP has been detected in the air in this area (NUS, 1983).

1.2.2.3 Contaminant Movement and Direction of Movement - The primary means behind movement and transportation of dusts at the Havertown PCP site are air currents or wind. Wind direction and sustained wind speed will both affect where and how far the dusts are transported. As an example, if the wind speed in a particular area is consistently 15 mph and blowing in an easterly direction, one would expect dusts to spread a rather large distance to the east. Generally, calmer winds would spread the dusts a small distance, while steadier and stronger winds could spread the dust a much greater distance. A persistent wind direction would generally cause dusts to be carried in this direction, while continuously shifting wind patterns would cause dusts to be more diversely spread.

Additional factors that can affect both movement and direction of movement of dust are physical barriers, vertical air movements (currents), and precipitation. Physical barriers such as buildings act to block the movement of a dust plume in a specific direction. Precipitation acts as a medium to carry the contaminated dust to the land surface quicker than they may normally settle out. In the Havertown area, the prevailing wind direction is from the northwest and southwest, averaging 10 mph (DER, 1983). It should be noted that site-specific

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information does not exist for the Havertown site, and the preceding information was from Philadelphia International Airport.

The primary means behind movement of free-phase floating product and other chemical constituents contained beneath the ground surface is gravity flow and groundwater flow. Many of the chemical contaminants that were discharged on the ground surface or beneath the ground surface eventually end up in groundwater. If the chemical is water soluble, it will "mix" with the water and move along with the groundwater in its usual flow direction. If the chemical is not water soluble, it will either float on the groundwater surface (chemical specific gravity <1) or sink through the groundwater (specific gravity >1) until a barrier to movement is encountered. The direction of movement could still be that in which the groundwater is flowing; however, additional factors such as impermeable and more permeable zones in the rock or unconsolidated deposits and man-induced factors (pumping, sewers, etc.) can all affect flow direction and velocity. It should also be noted that during movement of the contaminant from ground surface to the water table, some of the contaminant will be adsorbed on soil particles. However, at Havertown, it appears the major portion of the contaminant was directly introduced to the shallow groundwater surface through use of the shallow disposal well. Even this disposal method allows adsorption to occur and leave an oil residue behind on the soil grains.

The general direction of groundwater movement at the Havertown PCP site is from west-northwest to east-southeast with some portion of discharge to Naylor's Run. It should also be noted that the storm sewer line located behind PCG intercepts

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groundwater flow to some degree and may affect contaminant movement.

In addition to movement by groundwater flow, contaminants are also transported via surface water. This occurs when contaminated water reaches Naylor's Run through either storm water runoff (direct runoff, storm sewers, etc.) or through groundwater discharge to the creek. Once the contaminated water enters the creek, it will move in the direction of normal streamflow. Naylor's Run flows in a southeasterly direction and eventually discharges into Cobbs Creek.

Another minor way of moving or transporting contamination off-site is by personnel and vehicular contamination. Both the soil and air are known to be contaminated on NWP property, and as a result of daily business operations at NWP, both people and vehicles will retain some of this particular contamination and transport it off-site.

1.2.2.4 Environmental Receptors - The area potentially affected by contaminant released from the Havertown PCP site is almost entirely urbanized. The contamination source (NWP) is located among several commercial establishments and surrounded by the usual urban mix of private homes, schools, stores, and recreational and industrial facilities. Because of this, humans potentially make up the most important receptor group. Current routes of exposure to the surrounding population may include ingestion of dust and soils containing contaminant concentrations and ingestion of food products exposed to contaminant concentrations. At present, the greatest chance for

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human exposure could occur from contaminated dusts and ingestion, inhalation or dermal contact with Naylor's Run sediment, water, or volatile chemicals volatilizing from the stream.

The primary receptor of contamination from NWP is Naylor's Run, where groundwater contaminated with free-phase and possible dissolved fuel oil and PCP-laden components enter the stream in the vicinity of the properties in the rear of Rittenhouse Circle.

Reports from previous sampling by government agencies established degraded water quality in Naylor's Run and identified detrimental effects on aquatic life beyond the boundaries of the present RI/FS investigation. Additional environmental receptors may include vegetation, wildlife and domestic animals, and agricultural or garden products.

1.2.3 Future Impacts of Site Conditions and Contaminant Migration

Because the shallow disposal well is no longer used to dispose of spent treating solutions and treating and handling procedures are better than in the past, additional releases of contaminants to the environment from NWP operations should be reduced. In addition, the fact that PCP/oil is no longer used on-site will prevent further releases of this material to the environment, thus compounding the problem that already exists because of previous releases of this material. However, a large amount of PCP containing oil is still present on the groundwater's surface and trapped in the saturated zone beneath the site, and as long as it remains, it will serve as a constant source of contamination to the area's groundwater and to Naylor's Run. Also, the soils situated on NWP's property are contaminated, and

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due to slow natural degradation processes, these soils will likely remain this way far into the future and, therefore, continue to provide a contaminant source to the area's air, soil, and water.

Because it appears that additional new releases of wood-treatment solutions to the environment have been reduced, the major impact of the site to the surrounding area will be from releases which were contributed during the early operational years of the plant. It should be stated that new releases of wood-treating solution constituents, especially metals, may occasionally occur as a result of normal operations at NWP.

Presently air, groundwater, soils, and surface water, both on and in the vicinity of NWP, exhibit varying degrees of contamination by wood-treatment chemicals and their breakdown constituents. If these chemicals are left in the environment, they will continue acting as a source of contamination and potential risk far into the future.

1.2.4 Actions Taken to Mitigate Problems and the Results of these Actions

To date, the major action taken to mitigate contamination problems at the Havertown PCP site has been the installation of an underflow dam constructed by the EPA to contain the floating oil fraction in Naylor's Run. Previously, a filter fence or oil containment boom was installed on Naylor's Run in the vicinity of the storm sewer discharge just east of PCG. This boom was installed at this location to contain PCP/oil which was discharging to Naylor's Run from the storm sewer. Although the filter fence did appear to contain some oil, the lack of

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continuous oil recovery system and continuous maintenance at this location did allow some oil to escape during normal flow and more oil to escape downstream during high flow periods. Also, if the filter fence was not inspected regularly, oversaturation of the filter material and breaches of the fence occurred which went unseen for several days. In addition to the underflow dam, warning signs and silt fencing were recently erected around the NWP plant site fencing to warn passersby and to prevent contaminated soil runoff onto adjacent properties.

Other actions reportedly taken to mitigate problems at the Havertown site included an oil pumping and recovery operation initiated by EPA, the installation of an oil interceptor trench, the grouting of abandoned sewer lines to prevent oil migration through these lines, and the installation of oil recovery wells on-site. Details concerning these various undertakings are sketchy (NUS, 1983).

Secondly, due to pressure from DER, NWP's facilities were updated in the mid-1960's, with plumbing improvements and the installation of containment basins helping to reduce the chance of spills and leaks to the environment.

Also, microbial degradation experiments have been conducted using soils from the Havertown PCP site in order to determine the ability for conducting this type of cleanup. More detail concerning these is provided in Chapter 8.0.

Finally, numerous environmental samplings, including this RI, have occurred at the Havertown PCP site to help determine the nature and extent of contamination here, which is the first step in deciding what action can be taken to mitigate problems.

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1.3 Remedial Investigation/Feasibility Study Investigation Summary

The Comprehensive Environmental Response and Liability Act (CERCLA) and its funding mechanism, the Hazardous Substance Response Trust Fund (Superfund), and the Superfund Amendments and Reauthorization Act (SARA) require that Federal action taken in response to hazardous substances in the environment be in accordance with the National Contingency Plan (NCP), which was revised in November, 1985. This Remedial Investigation/Feasibility Study (RI/FS) being conducted for the Commonwealth of Pennsylvania is one in a series of actions in the remedial response process outlined by the NCP.

In a RI/FS, field investigations of the suspected area of concern are conducted to obtain information to identify, select, and evaluate remedial action alternatives. The RI emphasizes data collection and site characterization and the FS emphasizes data analysis and evaluation of alternative actions.

1.3.1 Remedial Investigation for the Havertown PCP Site

The major elements of the RI for the Havertown PCP site included:

- o Development of work plans for the investigation including a Field Sampling Plan, Quality Assurance/Quality Control Plan, Health and Safety Plan, and a Community Relations Plan.
- o An initial site reconnaissance to confirm information obtained during the background investigation and to

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assess logistical and health and safety problems related to proposed field activities.

- o A preliminary field investigation, including extensive soil sampling, sediment sampling, surface water sampling and groundwater sampling at the Havertown PCP site, to determine both what chemicals are present on-site, and the extent and concentration of these chemicals in the various media.
- o An extensive groundwater investigation, including the installation of 18 new monitoring wells and the sampling of all newly installed wells and 10 selected previously installed monitoring wells.
- o Laboratory analysis of soil, sediment and water samples collected during the preliminary investigation, and laboratory analysis of groundwater samples collected after installation of 18 new monitoring wells. These samples were analyzed by REWAI's laboratory subcontractor, CompuChem Laboratories in Research Triangle Park, North Carolina, with the exception of the preliminary round dioxin/dibenzofuran samples, which were analyzed by California Analytical laboratory in West Sacramento, California, under the direction of the EPA.
- o Three separate rounds of air sampling to assess potential hazards to workers and residents from contaminants (dust) entrained in the air. This sampling

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was conducted by United States Testing Corporation from Hoboken, New Jersey, under subcontract to REWAI.

- o Data summarization and site characterization based on fieldwork and laboratory analysis. The major emphasis of the investigation was groundwater; however, air quality, soil, and surface water and sediments were also investigated. Using data acquired from these investigations, the nature and extent of contamination at the Havertown PCP site were determined.
- o Preparation of a draft remedial investigation report.
- o Preparation of a final remedial investigation report.

The following paragraphs summarize the objectives of the field investigations and how and why these investigations were conducted as part of the RI. Detailed discussions of the methodologies and procedures used during the field investigations can be found in subsequent sections concerning the individual investigations.

1.3.1.1 Initial Site Reconnaissance Survey Havertown PCP Site -

An initial site reconnaissance survey was performed to confirm basic information obtained during the background information research phase, and to assess logistical and health and safety problems related to future field activities. The scope of the site reconnaissance consisted of the following:

- o Both on-site and adjacent off-site areas were inspected by REWAI field crews for evidence of contamination,

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including signs of water pollution, stressed vegetation, effects on wildlife, physical hazards, and so on.

- o Obvious waste features were documented, including conditions and characteristics of waste and noticeable migration paths such as seepage breakout paths.
- o Potential sources of contamination were documented, including drippage from treated materials, on-site chemical storage tanks, the former injection well, and general handling procedures.
- o General information concerning topographic and surface conditions, soils, geology, air quality, surface water, and groundwater were obtained. Much of this information was used in subsequent sections of the report. Tentative surface water, sediment, and soil sampling locations were identified for the preliminary sampling round, and potential groundwater monitoring well locations were noted.
- o Initial air characterization of the site was conducted by U.S. Testing Corporation, Inc.

1.3.1.2 Preliminary Sampling Investigation at the Havertown PCP Site - Between July 13, 1987 and July 31, 1987, REWAI, under the direction of DER, conducted soil, sediment, surface water, and groundwater sampling at the Havertown PCP site. The purpose of this sampling event was three-fold:

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- o To determine what chemicals and what concentrations of chemicals are present in the different media at the site.
- o To aid in determining the levels of personal protection for future field investigative activities at the site.
- o The groundwater sampling was to aid in locating monitoring wells which were to be installed later in the field investigation.

All samples were collected by REWAI and analyzed for parameters on the HSL by CompuChem Laboratories, with the exception of dioxin/dibenzofuran samples, which were analyzed by California Analytical Laboratory, under the direction of EPA. Sample collection and analysis were conducted in accordance with the sampling and analysis protocol described in the Site Operations Plan (SOP) for the Havertown PCP site RI/FS. All sampling locations were selected by REWAI and approved in the field by DER's project officer.

1.3.1.2.1 Preliminary Soil Sampling at the Havertown PCP Site - The purpose of the soil sampling was to determine the presence, extent, and degree of soil contamination at the site and to establish or modify levels of personnel protection required for future invasive activities. Soil samples were collected at eight locations on NWP property, with collection depths ranging from ground surface to three feet. A total of 16 samples, including 1 duplicate sample, were collected and analyzed from NWP property. Due to the nature of the fill material used on NWP property, which consists, in part, of railroad ties and slag, the collection of soil samples was

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performed by using a backhoe to first dig a collection trench, then stainless steel troughs were used to acquire the sample from the desired depth in the trench. Samples to be analyzed were selected by reviewing the results of scanning the sample with an organic vapor analyzer-flame ionization detector (OVA-FID). A detailed description of the soil investigation is given in Section 5.1.

1.3.1.2.2 Preliminary Sediment Sampling at the Havertown PCP Site - The purpose of sediment sampling was to determine if contaminants are concentrated on the sediments and if the sediments are acting as a means of mechanical transport for the contaminants. This sampling would further determine if the contaminants are being retained by adsorption onto the sediments and to potentially identify sources of contaminant concentration in Naylor's Run. A total of 10 sediment samples were collected in Naylor's Run both upstream and downstream of the storm sewer discharge point. Samples were collected using laboratory-cleaned, stainless steel troughs, and were analyzed for the complete HSL, oil and grease, and dioxin/dibenzofurans. In most cases, sediment samples were collected in the same location as surface water samples. Additional details concerning sediment sampling at the Havertown PCP site and the results of this sampling are included in Section 6.2.

1.3.1.2.3 Preliminary Surface Water Sampling at the Havertown PCP Site - The purpose of surface water sampling was to determine the concentration of contaminants in different reaches of Naylor's Run. By comparing surface water chemistry along the stretch of Naylor's Run bordering the Havertown PCP site, it may be possible to determine where contaminants are entering the creek. It is also important to know whether concentrations of

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chemicals in Naylor's Run are high enough to present a risk to the general population. A total of 10 locations were sampled in Naylor's Run both upstream and downstream of the storm sewer discharge point. Surface water samples were collected directly into clean sample bottles and analyzed by the laboratory for the complete HSL, oil and grease, and dioxin/dibenzofurans. At each sampling location, field measurements were made for unstable chemical parameters which could change if not immediately measured. These parameters included dissolved oxygen, pH, specific conductance, and temperature. Results of the surface water sampling, as well as additional details concerning the sampling, are included in Section 6.1 of this RI report.

1.3.1.2.4 Preliminary Groundwater Sampling at the Havertown PCP Site - The purpose of the preliminary groundwater sampling conducted by REWAI at the Havertown PCP site was to determine the presence, extent, and degree of groundwater contamination at the site, and to help establish or modify levels of personnel protection required for the installation of 18 new monitoring wells on-site. In addition, results from the preliminary groundwater sampling aided in locating the 18 newly installed monitoring wells. A total of 10 existing monitoring wells were sampled during the preliminary sampling round. These included the following wells: HAV-02, HAV-07, HAV-08, HAV-10, R-2, R-4, NW-1-81, NW-2-81, NW-3-81, and NW-6-81. Samples were collected during this initial round after sufficient purging, using a new, laboratory-cleaned, stainless steel bailer in wells with no product, and from pumped discharge in wells containing product. All samples were collected by REWAI and analyzed by CompuChem Laboratories (with the exception of dioxin/dibenzofuran as stated before) in accordance with EPA sampling and analysis protocol. All collected samples were ~~grab samples~~ and the wells

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sampled were field approved by DER's project officer, Mr. Gary Moulder. Once again, field measurements were taken for unstable chemical parameters, including dissolved oxygen, pH, specific conductance, and temperature.

Results obtained during the initial investigation of soil, sediments, surface water, and groundwater at the Havertown PCP site were beneficial in determining the concentrations of contaminants in these media; in some cases, the extent of contamination in these media; levels of personnel protection necessary for future field activities; and aiding in placement of proposed monitoring wells and determining what additional investigative activities may be necessary.

1.3.1.3 Air Quality Sampling at the Havertown PCP Site - An air sampling program was developed for the Havertown PCP site and implemented as part of the RI to assess the effects, if any, that the fieldwork had on the general population. The interpretation of the results and effects of this monitoring will be included in the RA.

The air sampling program utilized a three-zone monitoring area, consisting of the following:

- o Upwind Zone - A site was selected in a predominantly upwind direction from the investigation area to establish background levels of air contaminants throughout each sampling period.
- o Downwind Zone - One sampling location was established in a downwind direction from the investigation area to

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determine whether RI activities or normal site conditions are affecting off-site air quality.

- o Support Zone - Air quality samples were also collected in the command post/support zone and decontamination area. It should be noted that many times during the RI investigation this zone appeared to be a downwind zone.

The air sampling stations remained the same throughout the entire Remedial Investigation; however, due to the variable nature of wind it is quite possible that at some time or another each station may have served as either a downwind or an upwind site. The air sampling program was also divided into three separate sampling phases as follows:

- o Pre-mobilization Air Quality Sampling - This phase occurred prior to initiation of field activities at the site, and in a sense, these samples serve as background samples.
- o Active Investigation Air Quality Sampling - This phase occurred very shortly after the completion of invasive activities at the site and roughly at the midpoint of the field investigation schedule.
- o Demobilization Air Quality Samples - The final set of air quality samples were collected shortly after the completion of field activities at the site.

During each air quality sampling phase, samples were collected by U. S. Testing Corporation by using portable air sampling pumps, which pull the sample through a Tenax tube that is capped upon

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completion of sampling and transported to the laboratory for analysis. For each sampling phase, a 24-hour composite air sample (8-hour samples collected for 3 consecutive days) was collected at each sampling location. Analyses performed on the collected air samples included the parameters on the HSL, oil and grease volatiles, and particulates and aerosols. Results and details concerning the air quality sampling are given in Section 7.0.

1.3.1.4 Installation of New Monitoring Wells at the Havertown PCP Site - Between January 18, 1988 and February 26, 1988, a total of 18 new monitoring wells were drilled and constructed at the Havertown PCP site. Drilling of the wells was conducted by Empire Soils Investigations, Inc. under REWAI supervision. These wells were necessary in part due to poor geologic information available from previous investigations, uncertain well constructions in already existing monitoring wells, the unsecure status of many of the existing monitoring wells which presents questions concerning water chemistry results, and the need for more detailed information concerning site hydrogeology and the nature and extent of contamination. A total of six locations were drilled at the Havertown site, with two locations situated on NWP property and four locations situated on PCG property. Each drilling location had a total of three 2-inch PVC wells installed, which in general consisted of a shallow screened well, an intermediate depth well, and a deep bedrock screened well. The installation of these new cluster-type wells helped attain information concerning the following:

- o A more detailed insight of site geology which shows four major units on-site: a fill unit, a highly weathered

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micaceous saprolite, a biotite-schist saprolite unit, and a biotite-schist/gneiss bedrock.

- o A more thorough understanding of horizontal groundwater flow directions and gradient.
- o Insight concerning vertical groundwater flow components and gradients across the site.
- o Permeabilities of the various geologic units on-site, which will have a direct effect on fluid movement through these various units, which in turn could affect contaminant movement.
- o Further detail concerning the nature and extent of contamination at the Havertown PCP site both in a horizontal extent and a vertical extent.

Additional details concerning the installation of these new monitoring wells and information acquired from these wells are presented in Chapter 5.0.

1.3.1.5 Hydrologic Testing and Sampling of Newly Installed Monitoring Wells and Sampling of Selected Existing Monitoring Wells - Upon completion of drilling and well development, pertaining to the new CW-series monitoring wells, REWAI conducted slug tests on the newly installed wells and a complete round of groundwater sampling, which included all of the newly installed wells and 10 selected existing monitoring wells, most of which had been sampled previously during the preliminary sampling round.

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In-situ hydraulic conductivity (permeability) of the saturated material was determined by means of the falling and rising-head conductivity test or "slug test" method. A data logger recorder along with a pressure transducer was utilized to continuously record changes in head levels in response to slug immersion and withdrawal. A total of four tests, including two immersion tests and two withdrawal tests, were conducted for each newly installed monitoring well.

In addition to slug tests, in-situ packer tests were performed during drilling of the six new deep bedrock wells. The test results provided a qualitative assessment of bedrock permeability for use in well construction determination. The packer tests were performed by Empire Soils Investigations, Inc. under REWAI supervision in the rock core hole using a single packer system. In most cases, a 10-foot rock interval was tested. Results of the packer tests and slug tests are presented in Section 5.3.4.

The purpose of this second, more extensive groundwater sampling round was two-fold:

- o To validate and confirm groundwater chemistry results acquired during the preliminary sampling round.
- o To better define the presence, extent, and degree of groundwater contamination at the site, so that appropriate and effective remedial measures can be formulated and risks to public health and the environment can be ascertained.

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During this sampling round, all 18 newly installed monitoring wells (CW-series) were sampled, as well as 10 selected existing monitoring wells including HAV-02, HAV-05, HAV-07, HAV-08, R-2, R-4, NW-1-81, NW-2-81, NW-3-81, and NW-6-81. With the exception of HAV-05 and the CW-series wells, these are the same wells that were sampled during the preliminary investigation at the site. HAV-05 was selected over HAV-10 because it was believed that HAV-05 had a better opportunity of intercepting any contaminant plume. All CW-series wells were sampled using dedicated Well-Wizard sampling pumps, while all other wells were sampled using a peristaltic pump. Samples were not bailed during this sampling event. All samples were collected by REWAI and analyzed by CompuChem Laboratories. As before, field measurements were taken for unstable chemical parameters, including dissolved oxygen, pH, specific conductance, and temperature. Results for this sampling round are detailed in Section 5.3.5.2.

1.3.1.6 Risk Assessment for the Havertown PCP Site - The RA for the Havertown PCP site will be conducted by the Greeley-Polhemus Group, Inc. (GPG) under subcontract to REWAI. The risk assessment will consider the impacts to public health and the environment arising from contamination of the site and off-site areas by chemicals and materials used in wood treatment at NWP from 1947 to present. Data collected during the field investigation phases of the RI/FS and other background data previously gathered and reported in the literature will form the basis for the risk assessment.

For this RI/FS, the risk assessment will be conducted as part of the feasibility study as agreed to by DER. The risk assessment will be conducted in accordance with guidance provided by the EPA in (1) "Guidance on Remedial Investigations Under CERCLA," May

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1985; (2) "Guidance on Feasibility Studies Under CERCLA," April 1985; (3) "The Endangerment Assessment Handbook," PRC Work Assignment #136, August 1985; (4) "Superfund Public Health Evaluation Manual," OSWER Directive 9285.4-1, October 1986; (5) Draft "Superfund Exposure Assessment Manual," OSWER Directive 9285.5-1, January 14, 1986; and (6) "Risk Assessment Guidelines," Federal Register Wednesday, September 24, 1986, page 34028. The objectives of the risk assessment include:

- o Determine the nature, occurrence, and distribution of contaminants in the soil, air, water, and food supply.
- o Determine the number of human receptors and the different environmental receptors that are exposed to excessive levels of contaminant concentrations.
- o Examine the migration, transport and fate of the various chemical constituents and as part of this determine the amount that receptors may receive based on information concerning the release, migration, transport, and fate of the constituents under likely environmental conditions.
- o Determine impacts (both human and environmental health effects) associated with exposure to excessive levels of contaminants present at the Havertown site.
- o Provide (as part of the FS) a risk assessment of alternative remedial actions evaluated, should assessment of risks to human health and the environment indicate the need for remedial action.

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1.3.2 Feasibility Study for the Havertown PCP Site

The major elements of the feasibility study for the Havertown PCP site include:

- o Identification of remedial response objectives and criteria.
- o Identification and screening of remedial response technologies.
- o Development of remedial alternatives, based on successfully screened technologies.
- o Evaluation of alternatives based on technical, environmental, and cost considerations.
- o Preparation of a draft FS report.
- o Selection of proposed remedial action alternative and development of conceptual design.
- o Preparation of final FS report.

These tasks will be detailed in the Feasibility Study report for the Havertown PCP site.

1.4 Overview of the Havertown PCP Site
Remedial Investigation Report Chapters

This report is divided into the following chapters:

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- Chapter 1.0: Provides background information about the site including location, physiography, facility description and operation, previous sampling or investigative events, nature and extent of contamination, and objectives and activities conducted as part of the RI/FS.
- Chapter 2.0: Describes the general natural and man-made setting of the site including land use, demographic characteristics, natural resources and site climatology/meteorology.
- Chapter 3.0: Defines the nature and types of wastes found at the Havertown PCP site.
- Chapter 4.0: Details REWAI's initial site reconnaissance investigation, which included a search for potential sources of contamination.
- Chapter 5.0: Details the hydrogeologic investigation that occurred at the Havertown PCP site as part of this RI/FS. This investigation can be subdivided into three major subgroups: 1) a site soil investigation, 2) a site geology investigation, and 3) a comprehensive groundwater investigation.

The site soil investigation details the collection of soil samples from NWP property, the analytical results of the collected samples, and the area of soils contaminated by constituents of wood-treating solutions.

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The site geology subsection uses information attained from wells drilled on NWP and PCG property to present in text and graphic form an insight of site subsurface geology.

Finally, the groundwater investigation subsection details the purpose for the groundwater investigation, monitoring well construction, groundwater sampling procedures and results, hydrogeologic testing and results, site groundwater hydrology, and insight of the extent of contamination and contaminant migration in the groundwater system.

Chapter 6.0: This chapter details the surface water and sediment investigation that occurred in Naylor's Run adjacent to NWP and PCG property. Sampling locations, procedures, analytical results, and a summary of the findings are presented.

Chapter 7.0: This chapter details the air investigation conducted at the Havertown PCP site. Air sampling locations, procedures, and results are presented.

Chapter 8.0: Presents information concerning previous biota investigations and microbe investigations at the Havertown PCP site.

Chapter 9.0: Presents an overview of the conclusions and describes recommended actions for contaminant

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control, recovery, and treatment at the Havertown
PCP site.

Chapter 10.0: Lists references used in the preparation of the RI
Report.

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2.0 HAVERTOWN PCP SITE FEATURES

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2.0 HAVERTOWN PCP SITE FEATURES

2.1 Demography

The Havertown PCP site study area that is discussed in this report is predominantly comprised of urban and suburban areas in Haverford Township, Delaware County, Pennsylvania. The Havertown PCP site is located in the borough of Havertown, which is centrally located in Haverford Township. In addition to Havertown, other towns in the immediate vicinity of the site include Oakmont, Brookline, Llanerch, and Manoa. The NWP wood treatment plant, which is believed to be the source of much of the contamination, occupies approximately two acres of land and consists of a small treatment building, above-ground chemical storage tanks, and wood storage areas all surrounded by a chain-link fence.

Table 2-1 is a detailed analysis of the population distribution for Haverford Township based on 1980 U. S. Census data, and is categorized by age, sex and race. The population of Haverford Township is 52,167 which is approximately eight percent of Delaware County's total of 633,810. There are 8500 housing units with an average of 2.99 persons per household. The median age is 34.01 years and 48.5 percent of the total population is male.

According to the 1980 U. S. Census, the distribution of population in terms of age group, sex, and median age is similar to that for Delaware County in general.

The population distribution can also be divided into five basic age groups; infants (0-4 years), children (5-14 years), teenagers (15-19 years), adults (20-64 years), and elderly (>64 years). The percentage distribution of age groups among the population of Haverford Township is similar to that for ~~AR 300101~~ Delaware County.

Table 2-1

1980 Census Data For Haverford Township

AGE/YEARS	White		Black		Hispanic	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
<5	1465	1361	29	28	14	13
5-9	1539	1500	40	30	15	8
10-14	1955	1903	31	42	15	11
15-19	2593	2122	55	41	31	21
20-24	2434	1985	52	48	30	13
25-29	1793	1826	46	39	12	14
30-34	1806	1778	28	35	14	13
35-39	1304	1480	27	37	9	13
40-44	1070	1213	32	39	6	9
45-49	1186	1403	35	38	6	3
50-54	1553	1746	29	36	5	7
55-59	1602	1810	34	25	5	7
60-64	1392	1591	26	27	4	2
65-69	1110	1378	25	37	8	7
70-74	782	1160	21	31	4	5
75-79	551	907	12	25	1	4
80-84	259	550	5	9	3	4
>85	196	413	6	12	1	2
TOTALS	24,590	26,126	533	579	183	156 = 52,167

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MALE - 25306 (48.5%)

FEMALE - 26861 (51.5%)

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Infants account for 5.6 percent of the population, children 13.6 percent, teenagers 9.3 percent, adults 57.1 percent, and elderly 14.4 percent.

2.2 Land Use and Natural Resources

Land uses in Delaware County can be divided into four major categories: urban, agricultural, forest, and other uses. Urban areas consist of residential, commercial, and industrial developments, which may, without proper planning, affect an area's water resources and environmental quality. Increased surface runoff leads to flooding, reduction of groundwater recharge, and may cause adverse effects to both groundwater and surface water quality. These problems may all be related to urbanization. Agricultural lands are important because of their capability to produce food, serve as wildlife habitats, and be maintained as open space to provide attractive landscapes. In addition, agricultural areas serve as important groundwater recharge areas. Forests and woodlands provide valuable timber resources, wildlife habitats, recreational opportunities, and are important components in water resource management. The "other uses" category includes federal noncropland, water areas, disturbed land, and miscellaneous uses (DER, 1983).

At the present time in Delaware County, two land use categories, "other uses" and urban, dominate the area. Other land uses occupy approximately 27,980 acres, which is 23.6 percent of the total county area. Urban land, with 72,520 acres, represents the largest land use in the county, occupying 61.2 percent of the total area. Much of the "other uses" category in Delaware County consists of quarrying operations, disturbed land, and water. Agricultural land comprises the third largest land category in

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the county with 14,000 acres (11.8 percent), and forest lands comprise the smallest land group, with only 3,900 acres or 3.4 percent of the total county area. Table 2-2 summarizes the land use categories and acreage for Delaware County. Figure 2-1 shows a land use map for Delaware County based on 1967 data. As much as one-half of the mapped agricultural and forested land is now urbanized.

In recent years, many areas surrounding Philadelphia have undergone major changes, so that much of the area--including eastern, central, and southern Delaware County--is now predominantly urbanized. It also appears as if this will be a trend that will continue for some time in the future.

The Havertown PCP site is situated in an area that is nearly 100 percent urbanized and consists of residential, commercial, and light industrial land uses. A few quarries exist nearby which would be classified under the "other use" category; however, this would make up only a small percentage in the study area.

Due to urbanization in the Havertown area and in Delaware County, natural resources are not nearly as plentiful as they would have been in the past. Both agricultural and forested land have decreased significantly over the past 20 years, and it appears as if the trend will continue in the future. Natural resources present in the Havertown area include wetlands for waterfowl observation, some fishing in local watercourses, and mineral resources.

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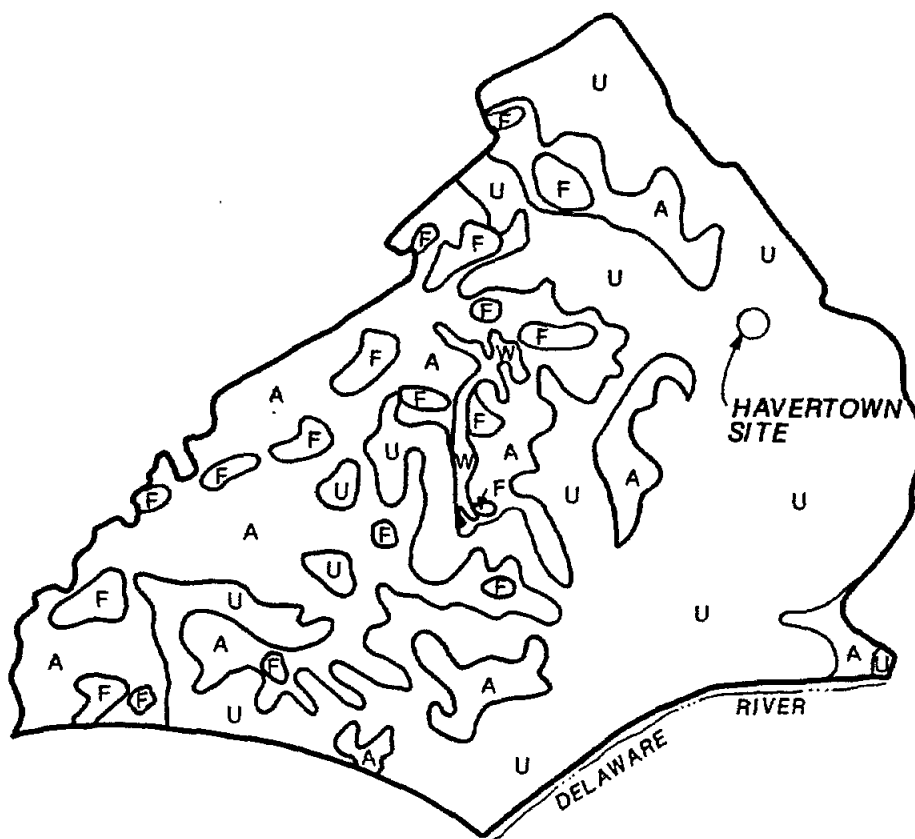
Table 2-2

Land Use Categories and Acreage
for Delaware County

(Source: USDA, Economic Research Service, 1974)

<u>Land Use</u>	<u>Acres</u>	<u>Percent</u>
Urban	72,520	61.2
Agriculture	14,000	11.8
Forest	3,900	3.4
Other	<u>27,980</u>	<u>23.6</u>
Total	118,400	100.0

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LEGEND

- A AGRICULTURAL AND OPEN LAND
 U URBAN LAND AND OTHER USES LAND
 F FOREST LAND
 W WATER

NO SCALE

FIGURE 2-1

HAVERTOWN PCP SITE
 HAVERTOWN, PA

**LAND USE MAP FOR
 DELAWARE COUNTY**

drawn <i>CCS</i>	approved <i>JST</i>	drawing no.
checked <i>JST</i>	date <i>5-10-88</i>	86021-022-AA
r. e. wright associates, inc. earth resources consultants middletown pennsylvania		

(BASED ON 1967 DATA-OFFICE OF STATE PLANNING AND DEVELOPMENT,
 COMMONWEALTH OF PENNSYLVANIA)

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The Havertown area is located on a major waterfowl migration route that is part of the Atlantic flyway. This route is commonly flown by black ducks, Canadian geese, and diving ducks. On a regional basis, there are no significant wetlands providing waterfowl habitat, although open bodies of water may serve as resting areas for migrating waterfowl. However, there are some wetlands that are locally significant as waterfowl habitat. The most significant of these is the Tinicum Wildlife Preserve, located with the city limits of Philadelphia, approximately seven miles southeast of Havertown, and administered as a unit of the National Wildlife Refuge System by the Bureau of Sport Fisheries and Wildlife of the U. S. Department of Interior. Water from Naylor's Run, which is located on the Havertown PCP site, eventually enters this preserve via Cobbs Creek, and therefore, the preserve could potentially be affected by contamination from the Havertown site. Resident species of waterfowl at Tinicum Wildlife Preserve include black ducks, mallard ducks, and wood ducks. Canadian geese have also been on the increase as resident population in the area (DER, 1983).

In addition to waterfowl habitats, some streams in the area offer a low to medium quality fish habitat. Both Cobbs Creek and Darby Creek are listed as cold-water fishing streams by the Pennsylvania Fish Commission. Coldwater fish species include brook, brown, and rainbow trout. The Delaware River offers high quality fishing for bass, walleye, muskie, pike and migratory shad, striped bass, and eels (DER, 1983).

Finally, mineral resources comprise a minor natural resource in the study area. Several quarries, both inactive and active, occur in the study area. Rock taken from these quarries is used primarily as building stone and construction and fill material.

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South from the site, in the Coastal Plain Physiographic Province, there are excellent supplies of sand and gravel for construction purposes.

2.3 Climatology

A humid, middle latitude continental climate prevails in the Havertown area. This type of climate results from repeated invasions and interactions of tropical and polar air masses. The Delaware River Basin, in which Havertown is located, is situated in a storm corridor frequently visited by tropical disturbances and air masses that move northward from the Gulf of Mexico or along the Atlantic coastline of the United States. The continental polar air masses, which are sometimes referred to as the "prevailing westerlies," move from west to east, and as they move off the east coast, because the polar air mass is colder and heavier, it is overridden by the warmer and lighter tropical air mass which has moved northward along the coast. This interaction of two different air masses is called frontogenesis, and the result is usually moderate to heavy precipitation, which in the colder winter months can take the form of wet snow (DER, 1983).

A second type of storm pattern that is common to this area occurs when small storm cells that form off the Cape Hatteras, North Carolina coast move northward, intensifying greatly as they do so. This type of storm system generally produces moderate to heavy precipitation amounts. Occasionally, the normal west to east progression of the polar front is blocked by a large high pressure cell known as a "Bermuda High," which is usually positioned off the east coast. When this happens, numerous small waves moving along the polar front are triggered and produce intense precipitation along the stagnant front system, which if

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it persists for several days, as it can, causes extensive flooding (DER, 1983).

The normal succession of high and low pressure systems moving eastward across the United States produces weather changes in the area every few days in the winter and spring and less frequently, due to a slowing down of the general atmospheric circulation during the warmer months, in the summer and fall. In general, low pressure cyclonic systems usually dominate the area with southerly winds, rising temperatures, and some form of precipitation. The high pressure anticyclonic systems normally bring west to northwest winds, lowering temperatures, and clearing skies. Rainfall is normally plentiful all year but highest in the summer when tropical air masses dominate (DER, 1983).

Meteorological data collected from the National Weather Service's (NWS) station at Philadelphia International Airport reports an average annual temperature of 54.4°F (based on 1977 to 1987 NWS data). The warmest temperatures generally occur between the months of June and August, with average maximum temperatures ranging in the mid to upper 80's and average minimum temperatures ranging in the mid to upper 60's during this time. The coldest temperatures usually occur in January and February with average highs ranging in the upper 30's to low 40's and average lows ranging in the mid 20's. The minimum temperature ever reported in the area was -19°F, while the maximum temperature ever reported was 107°F. The frost-free period is usually about 200 days, occurring from approximately mid April to mid October. The study area normally receives an average of 43 inches of precipitation annually, with average monthly precipitation totals ranging from 2.8 inches in February to 4.7 inches in August.

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Table 2-3 shows precipitation and temperature statistics for the Philadelphia area for the 1987 calendar year. Table 2-4 shows total precipitation received and average yearly temperatures for the Philadelphia area from 1977 to 1987, and Table 2-5 gives daily precipitation amounts for the area during on-site field investigations.

On the average, a snowfall of 10 inches or more in an individual storm occurs about once every five years. Snowfall over the entire area averages between 20 and 30 inches per year. The prevailing wind direction in the study area is from the west-northwest during the winter months and from the south-southwest during the summer months, averaging approximately 10 mph. Figure 2-2 shows a wind rose diagram for data collected in 1983 at Philadelphia International Airport. A strong vertical wind gradient was also observed at the Havertown site during field investigative activities (DER, 1983).

Relative humidity, like wind, also affects evaporation processes. The mean monthly relative humidities in the Philadelphia area for the months of January, April, July, and October are approximately 70 percent, respectively. The mean annual sunshine in hours per year for the study area is about 2,600 hours (DER, 1983).

Finally, evaporation is controlled by temperature, wind, sunshine, and humidity, and a high evaporation rate can cause humid regions to become vulnerable to drought. In this study area, approximately 72 percent of the annual total evaporation occurs between the months of May and October (DER, 1983).

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Table 2-3

Climatological Data for Calendar Year 1987
(from Philadelphia International Airport Weather Station)

<u>Month</u>	<u>Total Precipitation (inches)</u>	<u>Snow (inches)</u>	<u>Max/Min Avg. Temp. (°F)</u>	<u>Average Temp. (°F)</u>
January 1987	4.58	15.2	38.4/25.4	31.9
February 1987	1.17	10.1	40.9/24.0	32.5
March 1987	1.16	T	56.9/34.5	45.7
April 1987	3.63	T	62.5/43.7	53.1
May 1987	3.15	0	74.6/53.2	63.9
June 1987	2.01	0	84.6/64.6	74.6
July 1987	4.82	0	89.2/69.8	79.5
August 1987	3.72	0	85.2/65.6	75.4
September 1987	2.78	0	77.7/59.9	68.8
October 1987	2.62	0	63.6/41.4	52.5
November 1987	2.08	1.40	57.7/38.3	48.0
December 1987	<u>1.68</u>	<u>1.50</u>	<u>47.1/31.3</u>	<u>39.2</u>
Totals/Average	33.40	28.2	64.9/50.0	55.4

T - Denotes Trace Amount

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Table 2-4

Total Precipitation and Average Yearly Temperature 1977-1987
(from Philadelphia International Airport Weather Station)

<u>Year</u>	<u>Total Precipitation (inches)</u>	<u>Average Temperature (°F)</u>
1987	33.40	55.4
1986	40.42	55.3
1985	35.20	54.9
1984	43.66	53.8
1983	54.66	54.7
1982	40.43	54.2
1981	37.83	53.7
1980	38.80	54.5
1979	52.79	54.5
1978	45.95	53.5
1977	49.42	54.3
Average	42.96	54.4

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Table 2-5

Precipitation During Havertown Field Investigations - 1988
(from Philadelphia International Airport Weather Station)

<u>Date</u>	<u>Precip. (inches)</u>	<u>Date</u>	<u>Precip, (inches)</u>	<u>Date</u>	<u>Precip. (inches)</u>
January 19	.02	February 8		March 1	T/TS
20	.70	9		2	
21	T	10		3	.03
22	T	11	.36/1.25	4	.76
23	T/TS	12	1.35/.35	5	
24		13		6	
25	.72/3.05	14		7	
26	.08/ .95	15		8	
27		16		9	
28		17		10	
29		18		11	
30		19	.31	12	T
31		20	.11	13	.04
		21	.72	14	
February 1	T	22	.09	15	
2	.55	23	.04	16	
3	.01/TS	24		17	
4	.54	25	T	18	.01
5	T/TS	26			
6		27	.03/TS		

T - Trace Rain

TS - Trace Snow

Blank - No Precipitation

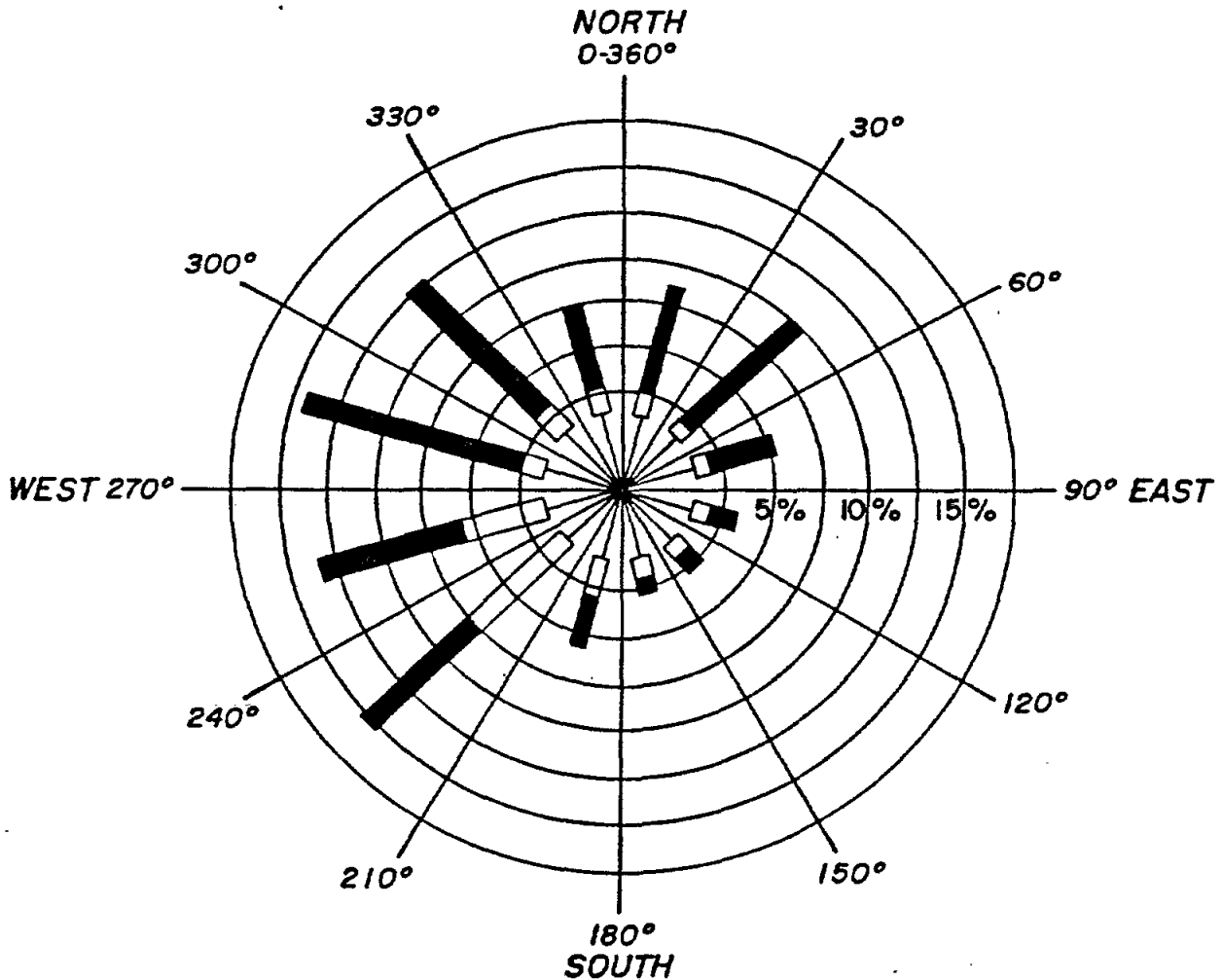
.72/3.05 - .72 Inches Rain/3.05 Inches Snow

Note - Solitary numbers are rainfall amounts in inches.

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FIGURE 2-2
1983 SUMMARY
WIND ROSE

(DATA FROM THE PHILADELPHIA AIRPORT AS REPORTED BY NOAA)



99 mph - HIGHEST AVERAGE WIND SPEED
(OCCURRED IN 270°-300° QUADRANT)
(WIND BLOWS FROM THE DIRECTION INDICATED)

SOURCE: LOCAL CLIMATOLOGICAL DATA, ENVIRONMENTAL DATA AND
INFORMATION SOURCE, NATIONAL OCEANIC AND ATMOSPHERIC
ADMINISTRATION, WASHINGTON, D.C., 1983

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2-5

Table 2-2

Land Use Categories and Acreage
for Delaware County

(Source: USDA, Economic Research Service, 1974)

<u>Land Use</u>	<u>Acres</u>	<u>Percent</u>
Urban	72,520	61.2
Agriculture	14,000	11.8
Forest	3,900	3.4
Other	<u>27,980</u>	<u>23.6</u>
Total	118,400	100.0

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3.0 HAZARDOUS SUBSTANCES

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3.0 HAZARDOUS SUBSTANCES

Air, soils, and water at the Havertown PCP site are known, from both this investigation and previous investigations, to contain elevated concentrations of chemicals which are, at least in part, the direct result of wood treatment processes at NWP. These elevated concentrations are most likely the result of disposal of spent wood treatment solutions (primarily PCP/oil) in a shallow disposal well, which was reported to commonly occur prior to 1963. In addition to this disposal method, accidental spills, leaks, and treated wood drippage are also responsible for chemical releases to the environment. The constituents of greatest concern in this investigation are: pentachlorophenol (PCP), fuel oil and its related components, chlorinated dioxin and dibenzofurans, heavy metals, and volatile organic compounds (more specifically solvents). These constituents occur in the environment in a variety of forms and can be toxic. For this RI/FS, the RA will be conducted as part of the FS as agreed upon by DER. The following sections provide background information about the constituents of concern at the Havertown PCP site with regard to common physical and chemical characteristics, and reported toxicological effects.

3.1 Physical, Chemical, and Hazardous Characteristics

3.1.1 Contaminant Form

The constituents of concern at the Havertown PCP site are generally found in four forms; they occur adsorbed on the surface of soil particles which gives them a solid particulate form, they occur along with and dissolved in the free-floating oil phase, they occur dissolved in both ground and surface water, and they can occur in gaseous form as a result of wood treatment procedures or volatilization from media over time.

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3.1.2 Contaminants of Concern at the Havertown PCP Site

Due to past on-site disposal practices, accidental spills and leakage, and materials handling and storage, wood treating solutions and their chemical constituents, and breakdown products have contaminated the environment at the Havertown PCP site. Exact quantities of spent wood treating solutions disposed of at NWP prior to 1963 are not known, but previous investigations have reported that approximately one million gallons of PCP/oil alone were disposed of in the shallow disposal well between 1947 and 1963 (NUS, 1983).

Many of the constituent chemicals detected in environmental sampling at the Havertown PCP site are toxic. The following briefly discusses a few of the constituent chemicals of wood treating solutions and gives information concerning their toxicological effects, and physical and chemical characteristics. This information was taken from the Merck Index ninth edition; the EPA publication entitled "Quality Criteria for Water" 1976; the OSHA Hazardline; a publication entitled "Chlorinated Dioxins and Dibenzofurans in Perspective" edited by Christoffer Rappe, Gangadhar Choudhory and Lawrence Keith, 1987; and a New Jersey Geological Survey Technical Memorandum (87-4) entitled "Water Soluble Phase of Number 2 Fuel Oil: Results of a Laboratory Mixing Experiment," 1987.

3.1.2.1 Pentachlorophenol (PCP) - PCP (C_6HCl_5O /molecular weight-266.35) commonly occurs as a white powder or needle-like crystals, but in its pure form it appears as dark-colored flakes. PCP has a very pungent odor when hot, is somewhat soluble in water (14 mg/l at 20°C), is freely soluble in alcohol and ether, and soluble in benzene. PCP is also used in the manufacture of

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a sodium salt (sodium pentachlorophenate) which is soluble in water. PCP and its salt preparation are toxic.

PCP does not occur naturally but is prepared by the chlorination of phenol in the presence of a catalyst. PCP is used as an insecticide for termite control; a pre-harvest defoliant; a general herbicide; and has been recommended for use in the preservation of wood, wood products, starches, and glues.

Laboratory experiments have shown PCP to be a carcinogen; PCP is an irritant to the mucous membranes and eyes in addition to being a primary skin irritant. The threshold limit value (TLV) for dermal contact with PCP has been established at 0.5 mg/m^3 . Dermal exposure can result in contact dermatitis and chloracne, which is an acneform eruption caused by contact with chlorine compounds. Acute PCP poisoning, usually through ingestion, is marked by motor weakness followed by increases and then decreases of respiration, blood pressure, and urinary output. Chronic exposure to PCP results in accumulation of the chemical in the liver, kidneys, and intestines, which can eventually cause damage of these vital organs. PCP is considered immediately dangerous to life or health at concentrations of 150 mg/m^3 . PCP can be absorbed into the body via dermal, inhalation and ingestion routes.

The presence of PCP in the environment at the Havertown PCP site is the result of using a five percent mixture of PCP and a petroleum solvent, similar to No. 2 fuel oil, and mineral spirits to treat wood at NWP from 1947 to 1978. Soils became saturated with this mixture as treated lumber was allowed to drip dry around the property. Groundwater became contaminated through the practice of disposing the spent mixture into the subsurface. The PCP/oil mixture is also the source of other impurities detected

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at Havertown such as lesser chlorinated phenolics, polynuclear aromatic hydrocarbons, dibenzofurans and various dioxin isomers.

3.1.2.2 Fuel Oil and Related Compounds - The major treatment solution used at NWP from 1947 to 1978 was five percent PCP dissolved in a petroleum solvent similar to diesel fuel oil. This fuel oil is referred to in the trade as P-9 Type A oil and is a brown slightly viscous liquid that has a characteristic fuel oil refinery odor (Todd, 1984). The specific gravity of pure fuel oil is 0.879, which indicates that this material will float on top of water. An actual measurement of specific gravity by Wright Lab Services, Inc. (WLSI) for the oil at the Havertown site gave a value of 0.897, and is higher than the value for pure fuel oil due to other additives such as PCP. Fuel oil is a recognized carcinogen (OSHA Hazardline).

Fuel oil is comprised of many different components from the base neutral/acid extractable (BNA) group and the volatile organics group. The primary constituents from the volatile organics group are benzene, ethylbenzene, toluene and xylene. Benzene, ethylbenzene and toluene are listed as priority pollutant volatile organics by EPA.

- o Benzene (C_6H_6 /molecular weight - 78.11) is a clear, colorless, highly flammable liquid that has a characteristic odor. Benzene is soluble in water at 1780 mg/l at 20°C and miscible with alcohol, chloroform, ether, carbon disulfide, carbon tetrachloride, glacial acetic acid, acetone, and oils. Benzene was discovered by Faraday in compressed oil gas in 1825 and today is obtained in the coking of coal and in the production of illuminating gas from coal.

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Benzene is used in the manufacture of medicinal chemicals, dyes, and many other organic compounds, and is also used as a solvent for waxes, resins and oils. Benzene can be acutely toxic through ingestion or inhalation. Symptoms of benzene toxication are irritation of mucous membranes, restlessness, convulsions, excitement and depression. Death can follow from respiratory failure. Benzene also appears to cause bone marrow depression and has been linked to leukemia. Finally, harmful amounts of benzene can be absorbed through the skin, so dermal protection is very important when working around this chemical.

- o Ethylbenzene (C_8H_{10} /molecular weight 106.16) is a colorless liquid that is flammable and has a density of 0.866. Ethylbenzene is somewhat soluble in water (152 mg/l at 20°C) and is miscible with the usual organic solvents. A concentration of 10,400 ppm in air has been found to be lethal for mice, and ethylbenzene is a known eye, skin and mucous membrane irritant, and was found to be narcotic in high concentrations.
- o Toluene (C_7H_8 /molecular weight 92.13) is a flammable, refractive liquid with a benzene-like odor that is obtained mainly from tar oil. The density of toluene is also 0.866 and it is moderately soluble in water at 515 mg/l at 20°C and miscible with the same liquids as benzene. Toluene is used in the manufacture of benzoic acid, benzaldehyde, explosives, dyes, and many other organic compounds. Toluene has been found to be less toxic than benzene and is narcotic in high concentrations.

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- o Xylene (C_8H_{10} /molecular weight 106.16) is a colorless, highly mobile, flammable liquid with a density of about 0.86 that is practically insoluble in water (198 mg/l at 25°C) and miscible with many organic liquids. It is obtained primarily from coal tar and is generally a mixture of three isomers; o-xylene, m-xylene, and p-xylene, with m-xylene normally predominating.

Xylene is used as a solvent, as a raw material in the production of many acids, in the manufacture of dyes and other organics, and as a cleaning agent in microscope technique. Xylenes' chronic toxicity is not well defined but it is less than benzene, and as with the other volatile constituents, xylene may be narcotic in high concentrations. Table 3-1 lists water quality criteria from a number of sources for benzene, toluene and xylene.

Additional volatile organic compounds comprising No. 2 fuel oil include methyl isobutyl ketone, various cyclohexane isomers, pentalene, and numerous other benzene isomers. The primary constituents from the base neutral/acid extractable group are fluorene, naphthalene and related isomers, phenanthrene, pyrene, various C_{10} - C_{20} hydrocarbon isomers, octane, and pentacozane. Of these components, naphthalene and the C_{10} - C_{20} hydrocarbon isomers generally comprise the largest portion of the BNA group.

- o Naphthalene ($C_{10}H_8$ /molecular weight 128.16) generally occurs as a white crystalline, highly volatile solid in flake or powder form and has the distinct odor of moth balls. The density of naphthalene is 1.582. Naphthalene is insoluble in water and highly soluble in

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Table 3-1

Water Quality Criteria (ug/l)

<u>Compound Name</u>	<u>MCL¹</u>	<u>CAG²</u>	<u>AMB WTR³ Qual Crit</u>	<u>AADI⁴</u>	<u>DER⁵ Criteria</u>
Benzene	5	1.3	0.66	25	0.66
Toluene	--	--	14300	--	14300
Xylene	--	--	620	--	--

1 - Federal Register, July 8, 1987. National Primary Drinking Water Regulations Final Rule - Maximum Contaminant Levels (MCL's), Effective January 9, 1988. Bases: Best Available Technology.

2 - Federal Register, June 12, 1984. Carcinogen Assessment Group (CAG) EPA 10^{-6} Cancer Risk.

3 - Federal Register, November 28, 1980. Ambient Water Quality Criteria for Various Substances by EPA Office of Water Regulations.

4 - Acceptable Daily Intake (no observed adverse effect level) Carcinogenic Effects Not Considered. Federal Register, June 12, 1984.

5 - Pennsylvania Department of Environmental Resources (DER), March 1984, Chapter 93, "Appendix C, EPA Recommended In-stream Water Quality Criteria and Threshold Levels, and DER Water Quality Criteria for the Priority Pollutants." Based on Human Health 10^{-6} Cancer Risk, or Taste and Odor.

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-- No Criteria Established

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benzene, toluene, turpentine, carbon tetrachloride, carbon disulfide, and oils.

Naphthalene is used in the manufacture of phthalic and anthranilic acids, dye industry compounds, synthetic resins, celluloid, and solvents used in lubricants and motor fuel oils. At one time, naphthalene was also used as a moth repellent and insecticide but this has decreased as a result of the introduction of chlorinated compounds such as p-dichlorobenzene.

Naphthalene poisoning may occur by ingestion of large doses, inhalation, or skin absorption with symptoms including nausea, vomiting, headache, fever, diaphoresis, hematuria, hemolytic anemia, hepatic necrosis, convulsions, and coma.

- o C₁₀-C₂₀ hydrocarbon isomers (chemical formula and molecular weight vary) comprise many compounds which are normally constituents of fuel oil. These include decane; undecane; undecane, 3,6-dimethyl; tridecane; hexadecane; pentadecane; tridecane, 7-propyl; decane, 6-ethyl-2-methyl; dodecane, 2,7,10-trimethyl; and dodecane, 2-methyl-6-propyl. Most of these compounds are colorless liquids with a density that is less than water (decane's density is 0.730). In addition, most of these compounds are insoluble in water and quite soluble in many organic liquids.

Although decane itself is listed as a simple asphyxiant, dodecane is listed as an experimental carcinogen. Most compounds also have a narcotic effect at high

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concentrations and the vapor forms are generally moderately explosive.

- o Phenanthrene ($C_{14}H_{10}$ /molecular weight 178.22) occurs in coal tar generally as monoclinic crystals. Phenanthrene has a density of 1.179 and is practically insoluble in water and very soluble in organic solvents, especially in aromatic hydrocarbons. Solutions containing phenanthrene generally exhibit a blue fluorescence. Phenanthrene is listed as an experimental human carcinogen with dermal exposure and has an oral lethal dose limit of 700 mg/kg in mice.
- o Fluorene ($C_{13}H_{10}$ /molecular weight 166.21) and pyrene ($C_{16}H_{10}$ /molecular weight 202.24) both occur in coal tar as solid flakes or tablets and have a density which is greater than water. Both compounds are insoluble in water and fairly soluble in organic solvents. Toxicity data concerning these compounds is uncertain at this time.

The compounds discussed on the previous few pages comprise some of the major constituents of fuel oil but not nearly all of the constituents. In addition to fuel oil, mineral spirits were also occasionally used at NWP in the PCP solutions. Mineral spirits is a highly volatile, clear, colorless and non-fluorescent liquid with many properties similar to fuel oils. Toxicological effects are also similar to those of fuel oil. The greatest difference between the two liquids is the extreme volatility of mineral spirits.

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3.1.2.3 Dioxin

Dioxins were detected in groundwater and soil samples collected on NWP property during this RI. Dioxins were also detected in the PCP/oil mixture collected from monitoring well R-2. Dioxin ($C_{12}H_4Cl_4O_2$ /molecular weight 321.96) is normally a colorless crystalline solid which may decompose, when exposed to ultraviolet light. Dioxins consist of polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofuran (PCDFs) isomers that exhibit very similar chemical, physical and biological properties. The number of chlorine atoms in these compounds can vary between one and eight to produce 75 PCDD and 135 PCDF isomers. Dioxin is not very soluble in water and often occurs as an impurity along with PCP.

From a toxicological standpoint, 2,3,7,8-tetrachlorinated dibenzo-p-dioxin (TCDD) is the most studied and probably the most toxic of the 210 various isomers. PCP, which is the source of dioxins in the soils and groundwater at the Havertown site, typically contains decreasing amounts of octa- through penta-chlorinated dioxins and dibenzofurans.

Dioxin is a substance that is undergoing continuous research concerning toxicological data for humans. Currently, dioxin is a suspected human carcinogen although no exposure limit has been established to date. It is known that dioxins accumulate in the adipose tissue of humans, in addition to tissues of the adrenal, bone marrow, liver, muscle, spleen, kidney and lungs (listed in decreasing order).

Dioxin is a positive carcinogen in certain laboratory animals, as experiments on mice and rats indicate that small concentrations of dioxin can lead to cancer in various organs and can cause immune deficiencies, damage to the nervous system, congenital

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malformations, respiratory distress and death. The route of entries into the body for dioxin include inhalation, skin absorption, ingestion, and skin or eye contact. For maximum protection of human health from potential carcinogenic effects, it is suggested that TCDD concentrations in water be zero (OHSA Hazardline).

3.1.2.4 Heavy Metals - The heavy metals of concern to this investigation include those which were and are used in wood treatment at NWP. Currently, the two wood treatment solutions used most often at NWP are chromated copper arsenate (CCA) and chromated zinc chloride (CZC), which are both water soluble salt solutions. In addition to these, tri-butyl tin oxide has been used occasionally on-site. All of the heavy metals associated with these solutions (chromium, copper, arsenic, zinc, and tin) can be found naturally in the environment; however, larger concentrations can lead to adverse effects. At present, tin is not considered toxic.

- o Chromium (Cr/atomic weight 51.996) is a steel-gray, lustrous metal with a density of 7.14 and a melting point of 1900°C. Chromium is normally obtained from the chrome ore, chromite (FeCr_2O_4). Chromium is very hard, not very soluble, and reacts with dilute hydrochloric and sulfuric acid.

Uses for chromium include the manufacture of chrome-steel and chrome-nickel-steel alloys (stainless steel), increasing the resistance and durability of other metals, chrome-plating of metals, and as a tracer in various blood diseases.

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No harmful effects have been reported from the ingestion of trivalent chrome; however, hexavalent chrome has been found to be irritating and corrosive to the mucous membranes, causes lung cancer, leads to ulceration and perforation of the nasal septum, and causes respiratory complications. The Committee on Water Quality Criteria recommends that public water sources contain no more than 0.05 mg/l total chromium, largely on the basis that tolerable levels of the chromate ion are not known for man.

- o Arsenic (As/atomic weight 74.922) is a gray, shiny, brittle metal which when exposed to air forms a black oxide. A characteristic of arsenic is that when it is burned it gives off a strong garlic odor and dense white fumes. There is also a yellow modification of arsenic which has no metallic properties and is obtained by sudden cooling of arsenic vapor. Arsenic is found as an arsenide of true metals from which it is produced as a trioxide during smelting.

Arsenic is used in metallurgy for hardening copper and lead alloys, in the manufacture of certain types of glass, and its radioactive isotope is used as a tracer in toxicology.

Most forms of arsenic are toxic, with acute symptoms following ingestion including irritation of the gastro-intestinal tract, nausea, vomiting and diarrhea which can progress to shock and death. Chronic poisoning can result in skin disorders and degeneration of the liver and kidneys. The Committee on Water

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Quality Criteria recommended an arsenic concentration of 0.05 mg/l for public water supplies.

- o Copper (atomic weight 63.546) is a reddish, lustrous, ductile, malleable metal that becomes dull when exposed to air. In moist air, copper will become coated with green basic carbonate. The density of copper is 8.94 and the melting point is 1083°C. Although copper is insoluble in water, it is readily soluble in certain acids.

Copper occurs in nature as a native mineral in various mineral forms such as chalcopyrite (CuFeS_2), chalcocite (Cu_2S), bornite (Cu_5FeS_4), tetrahedrite ($\text{Cu}_{12}\text{Sb}_4\text{S}_{13}$), enargite (Cu_3AsS_4), anthlerite ($\text{Cu}_3\text{SO}_4[\text{OH}]_4$), cuprite (Cu_2O), and malachite ($\text{Cu}_2[\text{CO}_3][\text{OH}]_2$). The most important copper ores are sulfides, oxides and carbonates.

Uses for copper include among others the manufacturing of bronze, brass, and other copper alloys; electrical conductors; ammunition; copper salts; and coins. Oxides and sulfates of copper are used for pesticides, algicides, and fungicides.

Copper is an essential trace element for the propagation of plants, performs vital functions in several enzymes, and a major role in the synthesis of chlorophyll. A shortage of copper in the soil could cause chlorosis, which is characterized by yellowing of plant leaves. Copper is also required in animal metabolism and in some invertebrates is important to blood chemistry and for the synthesis of hemoglobin. Young children require approximately 0.1 mg/day of

copper for normal growth, while the daily requirement for adults is estimated to be 2.0 mg/day (USEPA, 1976). Acute and chronic exposure to copper can result in vomiting, skin disorders, and complications with the excretory and circulatory system.

The EPA Committee on Water Quality Criteria recommends a concentration for copper in water of 1.0 mg/l (secondary standard) because copper may impart a displeasing taste to the water above this concentration. No levels have been determined for soils at this time.

- o Zinc - (atomic weight 65.38) is a soft, bluish-white, lustrous metal that is stable in dry air but becomes covered with a white coating of basic carbonate on exposure to moist air. Zinc has a density of 7.14, a melting point of 419.5°C, and is not very soluble.

Zinc is usually found in nature as a sulfide and is often associated with sulfides of other metals such as lead, copper, cadmium, and iron. Most other zinc minerals have probably been formed as oxidation products of the sulfide. The major zinc ores include smithsonite (ZnCO_3), sphalerite (ZnS), zincite (ZnO), willemite (Zn_2SiO_4), franklinite (ZnFe_2O_4), and gahnite (ZnAl_2O_4).

Uses for zinc include galvanizing sheet iron; an ingredient of alloys such as brass and bronze, use as a protective coating for other metals to prevent corrosion, for electrical apparatus (especially dry cells), castings, printing plates; automotive equipment, a reducing agent in organic chemistry,

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extracting gold, purifying fats for soaps, and as a reagent in analytical chemistry.

Zinc is an essential and beneficial element in human metabolism. The daily requirement of zinc for preschool-aged children is 0.3 mg Zn/kg of body weight. The daily adult human intake averages 0 to 15 mg/kg zinc. Deficiency of zinc in children can lead to growth retardation. Inhalation of zinc fumes may result in sweet taste, throat dryness, cough, weakness, generalized aching, chills, fever, nausea and vomiting.

Because zinc concentrations of greater than 5.0 mg/l cause water to have a bitter taste, this is the recommended concentration for zinc in drinking water (Clean Water Act - Water Quality Criteria). This is purely aesthetic and not for health reasons. No levels have been determined for soils to date; however, quantities of zinc in soil are known to block the uptake of cadmium in soil by plants.

3.1.2.5 Phenol - Another wood treatment solution used in the early years of NWP's operation was fluoro chrome arsenate phenol (FCAP). This trace metal salt of phenol is classified as a highly toxic compound. As this compound breaks down in the environment, the chance exists for free phenol to be produced.

Phenol (C_6H_6O /molecular weight 94.11) is obtained from coal tar or made by fusing sodium benzene sulfonate with NaOH. Phenol usually occurs as colorless, acicular crystals or a white, crystalline mass which is poisonous and caustic. Phenol has a density of 1.071 and is prone to redden on exposure to air and light. As far as solubility, one gram of phenol dissolves in approximately 15 ml of water. Phenol is even more soluble in

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alcohol, chloroform, ether, glycerol, and volatile and fixed oils.

Phenol is used as a general disinfectant, either in solution or mixed with slaked lime for toilets, stables, cesspools, floors, and drains; in the manufacture of colorless or light-colored resins; in the manufacture of many medical and industrial organic compounds and dyes; and as a reagent in chemical analysis.

Toxicologically, ingestion of even small amounts of phenol may cause nausea, vomiting, circulatory collapse, tachypnea, paralysis, convulsions, coma, greenish or smoky colored urine, necrosis of the mouth and gastro-intestinal tract, and death from respiratory failure or cardiac arrest. The average fatal dose is listed as 15 grams but death from as little as one gram has been reported. Fatal poisoning can also occur by skin absorption over large areas. According to EPA Water Quality Criteria (1987), based on available toxicity data, the recommended concentration for phenol in drinking water is 3.5 mg/l.

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4.0 SITE RECONNAISSANCE INVESTIGATION

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4.0 SITE RECONNAISSANCE INVESTIGATION

The site reconnaissance investigation consisted of a detailed evaluation of the site with regard to structures and facilities, their operational use, their potential for subsurface contamination, observed contamination, and potential migration pathways. An initial site field investigation was performed by REWAI on June 4, 1987, and included a walkover of the entire site during which organic vapors were monitored, using a portable Photo Vac, Inc. total ionizables present (TIP) meter, and a background scan for radioactivity was performed using a FE International radiation meter. During this walkover, observations were made regarding contaminated and suspected contaminated areas. Further reconnaissance of the site was performed by REWAI periodically during the remedial investigation.

4.1 Potential Sources of Contamination

The waste materials produced as a result of wood-treating operations at NWP are believed to have entered the environment through four general ways:

- o Surface drippage from treated lumber.
- o Waste preservative subsurface disposal.
- o Above-ground storage tank and piping leakage.
- o Surface spills caused by improper handling of preservatives.

4.1.1 Drippage

Because treated wood products were removed from the pressure treatment cylinders and dip tank and stored on-site, excess preservatives falling onto the exposed soil surface are

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considered to be a drippage source of waste preservative contamination. A review of the historical aerial photographs, listed in Table 4-1, indicates that over three-quarters of the NWP property soil surface was affected by drippage from treated lumber. The northwest corner and along the western fence line (less than one-third of the property area) was not as affected by drippage, possibly the result of the area being used to store untreated lumber.

Historically, treated lumber appears to have been stored in any available location. Through at least 1965, treated lumber, as evidenced by surface staining, was stored at NWP along the west side of Eagle Road under what is now Young's Produce, Swiss Farm Market, the RI/FS support zone (support zone), and a short portion along the north side of Lawrence Road. Additional staining was observed from aerial photography along the southwestern building face of NWP. After 1967, the area under what is now Young's Produce was filled in for the construction of the Shell service station. By 1973, the area between the gas station (now Young's Produce) and the support zone had been filled in. Through these various stages of filling, the treated lumber continued to be stored along the transgressing western edge of fill, until approximately 1973, when it appears that the predominant treated wood storage area became the western fence line between Continental Motors and NWP. Surface staining was extensive in the northwest NWP property corner, as well as around and north of the storage tanks.

From 1973 to the present, the amount of surface staining at NWP appears to have diminished significantly, with most of the staining located around and north of the storage tanks. This may be the result of changing from PCP-based wood-treatment chemicals.

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Table 4-1

Historical Aerial Photographs

<u>Photo ID Location</u>	<u>Date</u>	<u>Scale</u>	<u>Source</u>
Havertown PCP Site	March 11, 1953	1:2,200	DER
Havertown PCP Site	June 14, 1958	1:2,200	DER
Havertown PCP Site	March 24, 1959	1:1,300	DER
Havertown PCP Site	April 1, 1965	1:2,400	DER
Havertown PCP Site	October 20, 1967	1:2,500	DER
Havertown PCP Site	February 13, 1973	1:1,500	DER
Havertown PCP Site	March 22, 1979	1:1,700	DER
Havertown PCP Site	January 15, 1986	1:1,800	DER

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in 1977-78 to chromated copper arsenate and chromated zinc chloride solutions.

4.1.2 Subsurface Disposal

As described in previous sections, from 1947 to 1963, waste PCP-contaminated wood preservatives were reportedly disposed of in a 25- to 35-foot deep well located under property leased to the Shell Oil Company in 1967 by the owner, Mr. Clifford A. Rogers (NUS, December, 1983, p. ES-1). The former Shell Oil Company service station property is presently used as a fruit and produce market known as Young's Produce.

During the site reconnaissance and later RI field activities, an attempt was made to further refine the location of the former disposal well by interviewing the present NWP plant operators. These interviews yielded no new information about the location of the disposal well; however, Mr. Allan Goldstein mentioned in an interview with DER and REWAI on July 28, 1987, that the disposal well was not really a well, but rather a hole in the ground. Mr. Goldstein elaborated that the hole used by the former owner (Mr. Samuel T. Jacoby) was located somewhere under Young's Produce Market and that, at the time of use, the disposal well was approximately at the same elevation as the present grade of NWP.

4.1.3 Storage Tanks

As discussed in Section 4.1.1, historical aerial photographs indicate a substantial area of surface contamination in and north of the storage tanks. In 1963, the present owners constructed a cinder block retaining wall around the storage tanks at the

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request of DER. The retaining wall's purpose was to prevent leakage or spills from the storage tanks from spreading further onto the soil surface.

The present NWP operation was noted to have at least two occurrences of leakage of fluid from the storage tanks during the RI drilling program. Substantial leakage from a single tank labeled CCA (chromated copper arsenate) was observed on two occasions. Fluid was noted exiting a horizontal seam on the northern side approximately three-quarters up the tank. The retaining wall appeared to have prevented the spill from reaching the soil surface outside of the wall; however, the integrity and construction of the tank storage area to prevent downward contaminant migration are not known. An NWP operator indicated that the storage tanks sit on a concrete platform of unknown dimensions. Hand augering performed in the storage tank area during the preliminary sampling round soil investigation indicated that approximately 16 inches of coarse sand and gravel, with some metal debris and plastic sheeting (fill) overlies what may have been the concrete pad. An oily substance was noted as filling in the hand-auger hole.

4.1.4 Handling Procedures

It is not known whether or not improper handling of wood-treating chemicals ever resulted in a surface spill; therefore, the overall effect on site contamination due to improper handling procedures is uncertain.

4.2 Relocation of Naylor's Run

During the review of historical aerial photographs for Section 4.1, it was observed that the location of Naylor's Run had

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changed over time. This change appears to have occurred during the construction of the Rittenhouse Circle subdivision.

Prior to the Rittenhouse Circle subdivision construction, circa 1953-1958, that portion of Naylors Run, which is now south of the abandoned PCRR railroad bed, was originally located approximately 100 to 130 feet south of its present position, shown on Plate 1. It appears that during the course of the subdivision's construction, the original stream channel was moved northward to allow sufficient room for construction.

In addition to the relocation of Naylors Run, verbal reports from long-term area residents indicate that a small tributary to Naylors Run used to be present under what is now the storm sewer pipe which runs behind PCG. Evidence for this small tributary was present on aerial photographs from the 1950's.

The locations of the old stream channels of Naylors Run may correspond to permeability anomalies of the aquifer. This change in permeability probably affects the migration of groundwater in this area by preferentially increasing permeability along the direction of the buried stream channel. The movement of groundwater contaminants could also be affected by this condition. The magnitude with which the old stream channels affect the migration of groundwater contaminants is not currently known and further fieldwork would be necessary to determine this.

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